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SWOD (SPECIAL WEAPON) MK 9

(BAT)

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(CO-NAVAER 28-10c-502)

SWOD (SPECIAL WEAPON) MK 9
(BAT)

DEPARTMENT OF THE NAVY
BUREAU OF ORDNANCE

27 MAY 1947

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NAVY DEPARTMENT
BUREAU OF ORDNANCE
WASHINGTON 25, D. C.

27 May 1947

CONFIDENTIAL
ORDNANCE PAMPHLET 1696
(CO-NAVAER 28-10c-502)
SWOD (SPECIAL WEAPON) MARK 9 (BAT)

1. Ordnance Pamphlet 1696 describes the operation, assembly, check-out, and handling of SWOD (Special Weapon) Mark 9 (BAT) with a thorough description of component parts not covered in other publications. The appendices of this publication give certain specific data and modification procedures which are necessary for the proper functioning of this missile.

2. Since cognizance of SWOD (Special Weapon) Mark 9 Mods 0 and 1 was transferred to the Bureau of Aeronautics on 15 February 1947, terminology and nomenclature used by the Bureau of Aeronautics have been inserted in parentheses where applicable throughout this publication. Where the two SWOD Mark 9 modifications are spoken of in general terms, such as in reference to a project or program, the use of the Bureau of Aeronautics nomenclature BAT can be interpreted as a general reference such as SWOD Mark 9. However, where specific modifications are under consideration, the broad term BAT will no longer apply and the SWOD Mark 9 Mod 0 will be referred to by the Bureau of Aeronautics nomenclature BAT-0 and the SWOD Mark 9 Mod 1 as BAT-1.

3. This publication does not supersede any existing publication.

4. It is not intended that this publication be carried in aircraft for use therein.

5. This publication is CONFIDENTIAL and shall be safeguarded in accordance with security provisions of U. S. Navy Regulations, 1920, Article 76.

G. F. Hussey Jr.

G. F. Hussey, Jr.
Vice Admiral, U. S. Navy,
Chief of the Bureau of Ordnance.

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NOTE

As explained in promulgating letter, paragraph 2, "terminology and nomenclature used by the Bureau of Aeronautics has been inserted in parenthesis where applicable" but this applies to text only. Drawings and illustrations are shown only with Bureau of Ordnance nomenclature.

A cross-reference of Bureau of Ordnance and coinciding Bureau of Aeronautics nomenclature is therefore included herewith.

Bureau of Ordnance Nomenclature	Bureau of Aeronautics Nomenclature	Type Designation	Security Class
SWOD (Radar) Mk 2 Mod 1	Radar Set	AN/DPN-1	C
SWOD (Radar) Mk 2 Mod 1 Bulk-head Assembly.	Transmitter-Receiver	RT-129/DPN-1	C
SWOD (Radar) Mk 2 Mod 2	Radar Set	AN/DPN-2	C
SWOD (Radar) Mk 2 Mod 2 Bulk-head Assembly.	Transmitter-Receiver	RT-130/DPN-2	C
Monitor Mk 2 Mod 1	Control Group	AN/APA-65	C
Monitor Mk 2 Mod 2	Control Group	AN/APA-66	C
Monitor Mk 3 Mod 0	Control Group	AN/APA-67	C
Connection Box Mk 5 Mod 1	Junction Box	J-233/APA-65	C
Connection Box Mk 5 Mod 2	Junction Box	J-234/APA-66	C
Connection Box Mk 3 Mod 0	Junction Box	J-235/APA-67	C
Operator's Indicator ID/Mks 2 & 3.	Indicator	ID-229/APA-65	C
Pilot's Indicator ID/Mk 16 Mod 1.	Indicator	ID-230/APA-65	C
Control Unit Mk 2 Mod 1	Control Monitor	C-436/APA-65	C
Control Unit Mk 2 Mod 2	Control Monitor	C-437/APA-66	C
Control Unit Mk 6 Mod 0	Control Monitor	C-438/APA-67	C
Mount MT/Mk 2	Mounting Rack	MT-565/APA-65	C
Mount MT/Mk 3	Mounting Rack	MT-566/APA-67	C
Battery Voltage Indicator MX/Mk 2.	Voltmeter	TS-631/APA-65	U
Battery Voltage and AVC Indicator MX/Mk 3.	Voltmeter	TS-632/APA-67	U
Inverter, 800-1-D	Inverter, 800-1-D	None	U
SWOD (Servo) Mk 4 Mod 4	Flight Control Servo	PU-145/DPN-1	C
SWOD (Gyro Panel) Mk 6 Mod 1.	Gyroscope Assembly	CN-75/DPN-1	C
SWOD (Servo) Mk 18 Mod 1	Flight Control Servo	PU-146/DPN-2	C
Directional Control Amplifier	Electronic Control Amplifier.	AM-209/DPN-2	C
Power Supply Mk 16 Mod 1	Power Supply	PP-284/DPN-1	U
Power Supply Mk 16 Mod 2	Power Supply	PP-285/DPN-2	U
Test Unit Mk 8 Mod 0	Test Meter	ME-4/U	U
Test Unit Mk 11 Mod 0	Test Meter	ME-5/DPN-1	U
Test Unit Mk 10 Mod 0	Test Coupler	CU-141/DPN-1	U
Test Unit Mk 9 Mod 0	Signal Generator	SG-7/DPN-1	U
Test Unit Mk 2 Mod 0	Test Set	TS-634/DPN-1	U
IF Power Supply and Tester	Test Set	TS-633/U	U
Range Unit Mk 9 Mod 0	Range Coordinator	SN-48/AP	C

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Chapter 1

INTRODUCTION

1. HISTORICAL BACKGROUND

The SWOD (Special Weapon) Mk 9, frequently referred to as "the BAT," is a guided missile developed during World War II under the direction of the Bureau of Ordnance. There have been two models of this weapon developed and a total of about 3,000 equipments produced. The early type, SWOD (Special Weapon) Mk 9 Mod 0 (BAT–0) shown in Figure 1, was in limited service use in the Pacific during the final months of the war. A later model, SWOD (Special Weapon) Mk 9 Mod 1 (BAT–1) of Figure 2 differs from the Mod 0 (BAT–0) mainly in the control system used for controlling the flight of the missile.

This publication is written in such a manner that both the SWOD (Special Weapon) Mk 9 Mod 0 (BAT–0) and Mod 1 (BAT–1) are described. In certain sections of the publication when neither the Mod 0 (BAT–0) nor Mod 1 (BAT–1) is specifically mentioned or where the weapon is referred to as (SWOD Special Weapon) Mk 9 (BAT) it should be understood that those sections apply to both models. Explanations which are applicable to only the SWOD (Special Weapon) Mk 9 Mod 0 (BAT–0) or SWOD (Special Weapon) Mk 9 Mod 1 (BAT–1) will be so designated by adding the mod number of the missile.

2. NATURE AND FUNCTION

SWOD (Special Weapon) Mk 9 (BAT) is a low-angle-of-flight, self-controlled airborne homing missile. It is essentially a 1,000-pound bomb mounted in a glider type airframe (air stabilizer) which is equipped with a radar transmitter and receiver to provide directional correction, a gyroscopic stabilizing unit, and a servo system to move the control surfaces of the air stabilizer. The complete unit is carried by aircraft suspended under a wing or below the fuselage.

In application this weapon is an armament item for aircraft designed for the purpose of attacking targets from moderate altitudes and advantageous ranges regardless of visibility conditions. The aerodynamic design enables a ratio between horizontal range and dropping altitude of between 3.5 and 5.5 and the overall design contemplates dropping at ranges up to 17 nautical miles. This weapon is not propelled; the power for the glide is derived from the speed at release and the pull of gravity.

In normal usage the target is located by the standard search radar of the plane. The plane is then headed toward the target and the radar transmitter and receiver in the weapon is directed toward the selected target. The target data from the radar in the missile is displayed on a separate electronic indicator, mounted in the parent plane, which is controlled and interpreted by the operator. After the radar equipment is manually adjusted to the proper conditions it is switched to automatic tracking. The plane is maneuvered to a position such that the missile may be released toward the target, with a consideration of the proper relationship between altitude and range.

After release the missile is completely self controlled and automatically homes on the selected target. The plane is free to pursue any desired course of further attack or evasion.

Directional correction of the weapon is obtained through the illumination of the target by the radar transmitter in the BAT. Thus echoes from the target are continuously detected by the radar receiver and the output to the flight control units indicates the direction of the target with respect to the axis of the missile.

To accomplish directional control, four signal channels are established throughout the system corresponding with the up, down, right, and left basic directional course correction required of the airframe during the homing flight. The flight control units (gyros and servos) respond to the directional signals by moving the control surfaces of the airframe, thus causing the missile to home on the target.

The bomb is mechanically armed by a flight of 2,500 to 3,000 feet after release, and explodes upon

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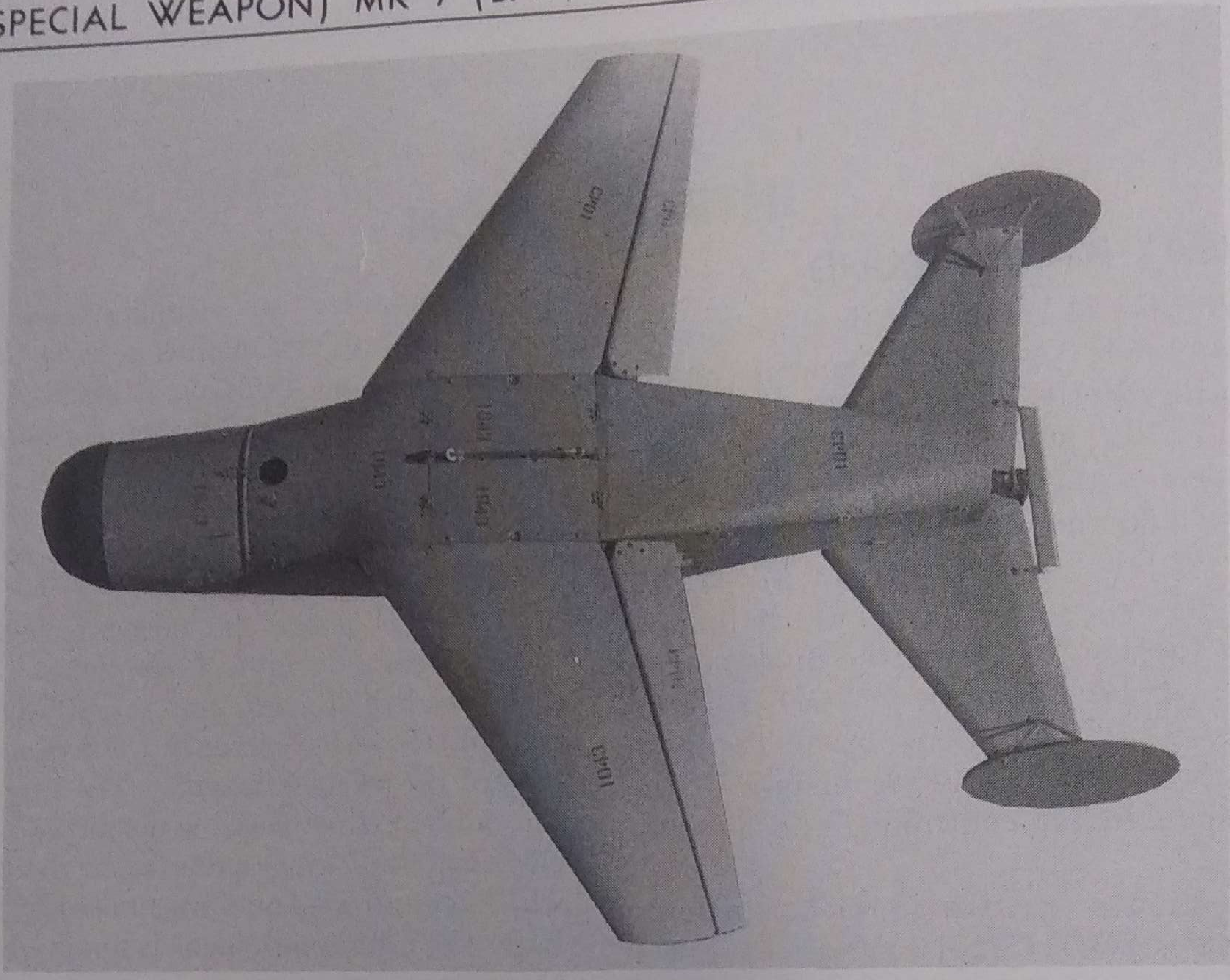

Figure 1—SWOD (Special Weapon) Mk 9 Mod 0.

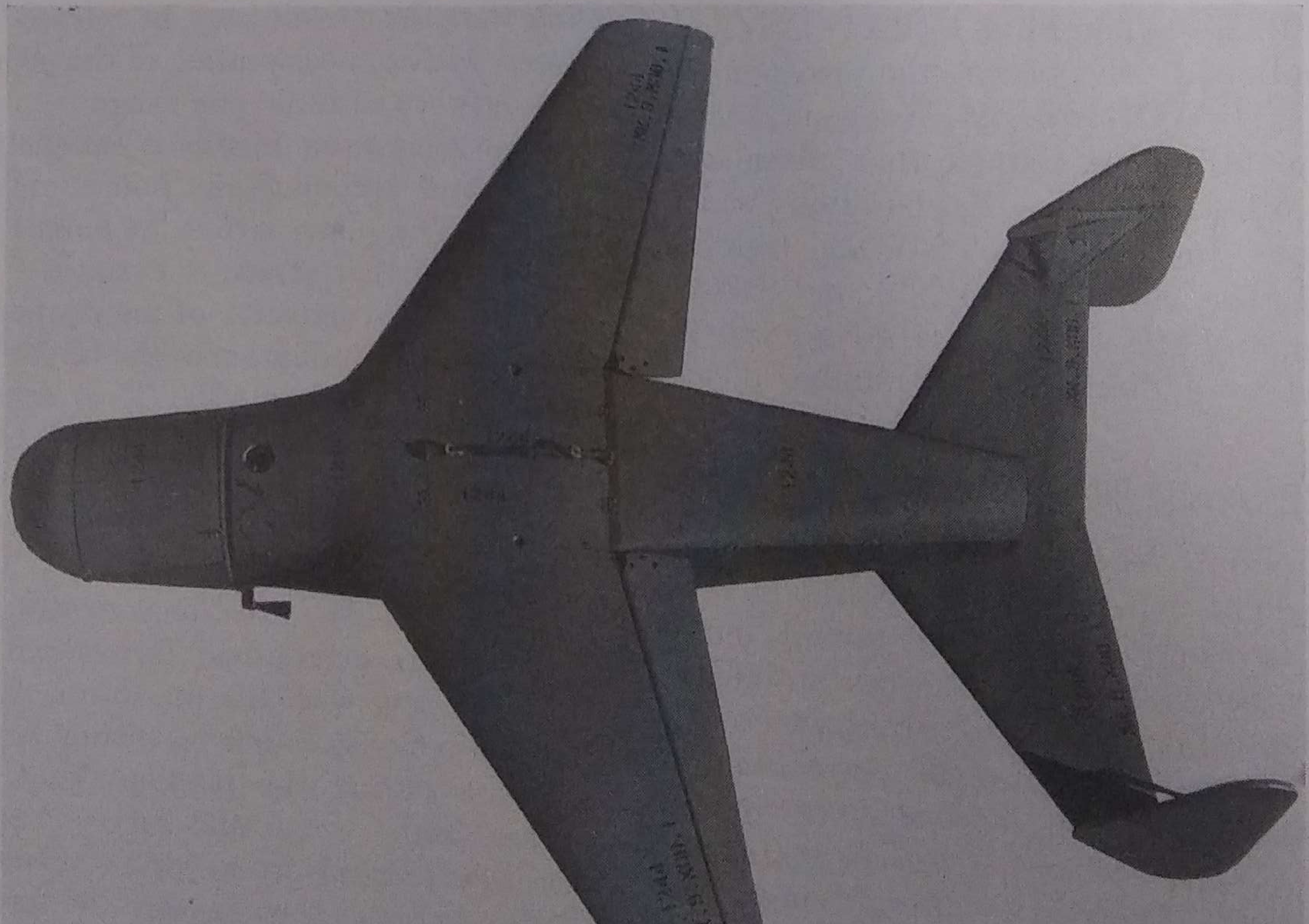

Figure 2—SWOD (Special Weapon) Mk 9 Mod 1.

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impact. The air stabilizer and contained equipment units are expended with the bomb.

The outstanding features of the BAT as a combat weapon are:

Long Range which provides a possibility of attacking heavily fortified targets with accuracy *outside the antiaircraft range.* Ranges up to 17 miles may be used.

Improved Accuracy provided through the self-homing feature.

High Pay Load provided by a 1,000-pound bomb.

Low Angle of Flight which reduces the high altitude problems.

Self-Sustaining After Release which allows the parent plane to maneuver as desired.

3. CHARACTERISTICS

The assembled SWOD (Special Weapon) Mk 9 (BAT) has the following general characteristics:

	Mod 0 (BAT–0)	Mod 1 (BAT–1)
Size	Wing span, 10 ft Over-all length, 11.9 ft	Same. 12.3 ft.
Weight	1,600 lbs. including bomb	Approx. 1,700 lbs.
Where Carried	Suspended under a wing or below the fuselage of the carrying plane, the arrangement depending on the type of plane used.	Same.
Launching Speed	140 to 210 knots with control surfaces set in neutral position	Same.
Launching Attitude	Released when parent plane is in a normal cruising attitude	Same.
Air Speed	170 to 320 knots	Same.
Glide Angle	8° to 35° as controlled by the elevon position	Same.
Temperature	Design permits stable operation between approximately −20 and +120° F. and under conditions of high humidity.	Same.
Arming	Approximately 2,500 to 3,000 ft. of air travel, after release from parent plane, is required to arm the bomb fuzes. Arming is accomplished in a conventional manner by vanes mounted in the air stream on the outside of the fuselage.	Same.

4. LIMITATIONS

	Mod 0 and Mod 1
Glide Ratios	The altitude of release governs the release range within the glide ratios of 3.5 to 1 and 5.5 to 1.
Range	The maximum slant range is approximately 17 miles (nautical). A minimum slant range of about 3 miles should be allowed to permit stabilization of flight for proper homing. The size and character of the target or low radar target contrast may limit the maximum range to less than 17 nautical miles.
Radius of Turn	Design requires relatively large radius of turn.
Interference	During the homing run the receiver must be free from excessive interference from other sources of ultra high frequency energy, such as other radar equipment of the same frequency.
Icing	Excessive external icing conditions would destroy the proper balance and control of the air stabilizer, and drops should not be made under these conditions.
Water	Submersion would temporarily incapacitate the electrical equipment of the units. However, proper homing performance is not affected by high atmospheric moisture or rain, as the equipment is protected within the air stabilizer. Radar transmission and reception is not impaired by rain.

5. PERSONNEL

The personnel entrusted with the assembly, checkout and operating of SWOD (Special Weapon) Mk 9 (BAT) and the associated control equipment should be proficient in this work.

Specialized technical training is required for the assembly, checkout, and maintenance procedures. However, operating and dropping techniques may be learned in a short time by personnel not technically trained.

A trained service unit for BAT is assigned to each squadron equipped to use this weapon. This unit is equipped to handle all phases of the ground work associated with BAT. This includes the unpacking, assembly, checkout, maintenance, and the loading of the complete units on the airplane together with the preflight checks of the missiles operating with the control equipment in the aircraft. The service unit is also equipped to maintain the control equipment for this weapon which is mounted in the plane.

Since the airplane crew is a fighting team a regular crew member would be assigned to operate the BAT equipment, and several crew members should be proficient in this work.

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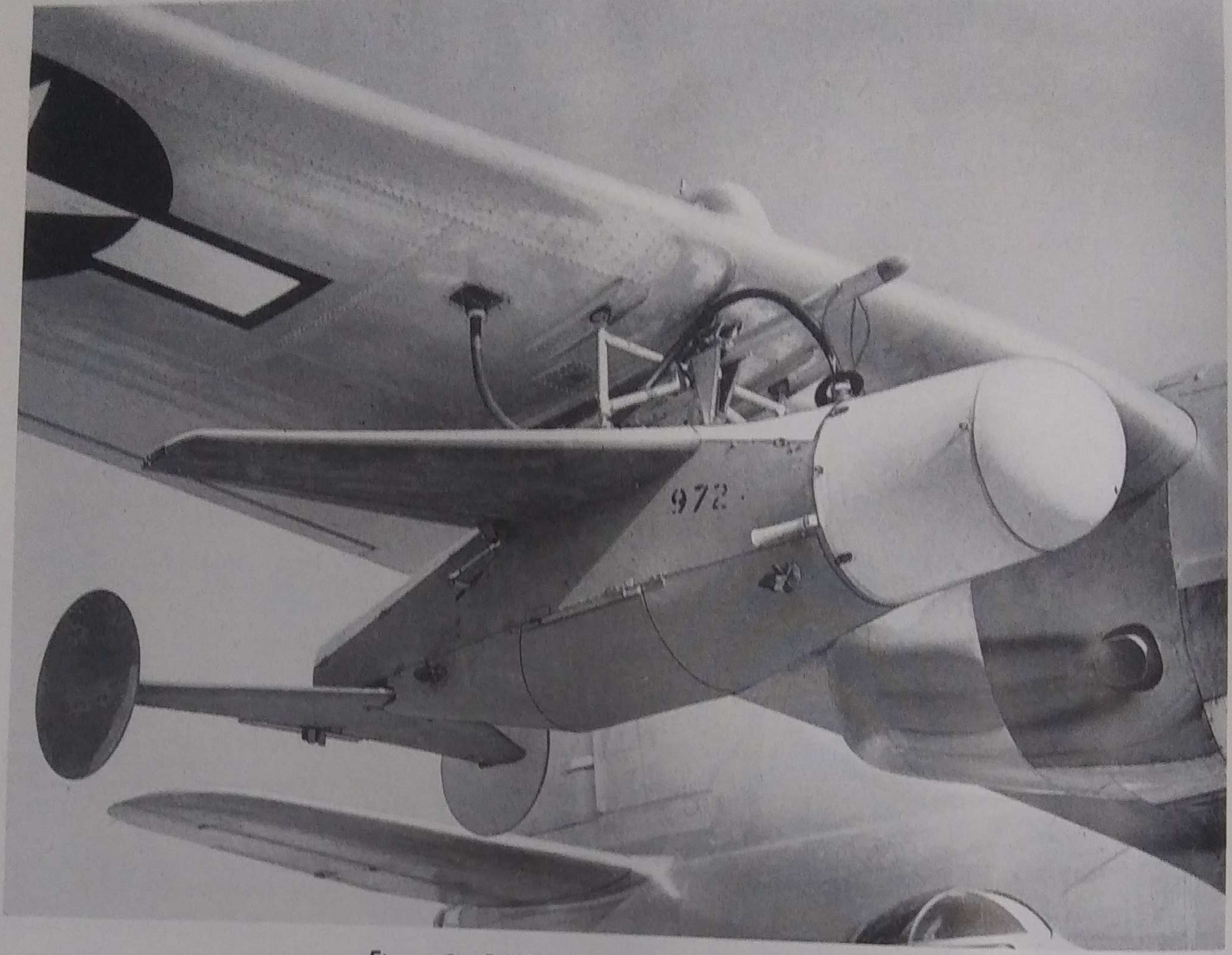

Figure 3—BAT On Wing of PB4Y-2

6. EMPLOYMENT

SWOD (Special Weapon) Mk 9 BAT has been developed to accomplish long range, high accuracy bombing from aircraft regardless of target visibility conditions. It is designed primarily for use against sea targets but under proper conditions may be used against land targets.

The BAT may be carried by aircraft as a weapon of opportunity or may be used for specific missions. The size of the pay load, a 1,000-pound bomb, is such that heavy damage will be effected by a direct or a skip hit on the target.

It is also applicable as a weapon in addition to the fighting equipment of the parent plane. As mounted it does not restrict the flight operations nor appreciably affect the flight characteristics of the plane. When mounted under the wings it does not interfere with the use of the bomb-bay for carrying standard bombs. Rocket racks may also be mounted and rockets used when desired. Machine gun or cannon positions are not affected by the addition of this weapon.

The BAT may be used with accuracy against fighting ships and fortified targets from ranges well outside the antiaircraft fire. Salvo drops are possible, as conditions warrant, in emergencies. From a defensive standpoint the BAT, due to its size and speed, is a difficult target for protective fire and the self-homing feature makes successful evasive tactics very difficult.

The BAT may be used in conjunction with land or carrier base operations. The following types

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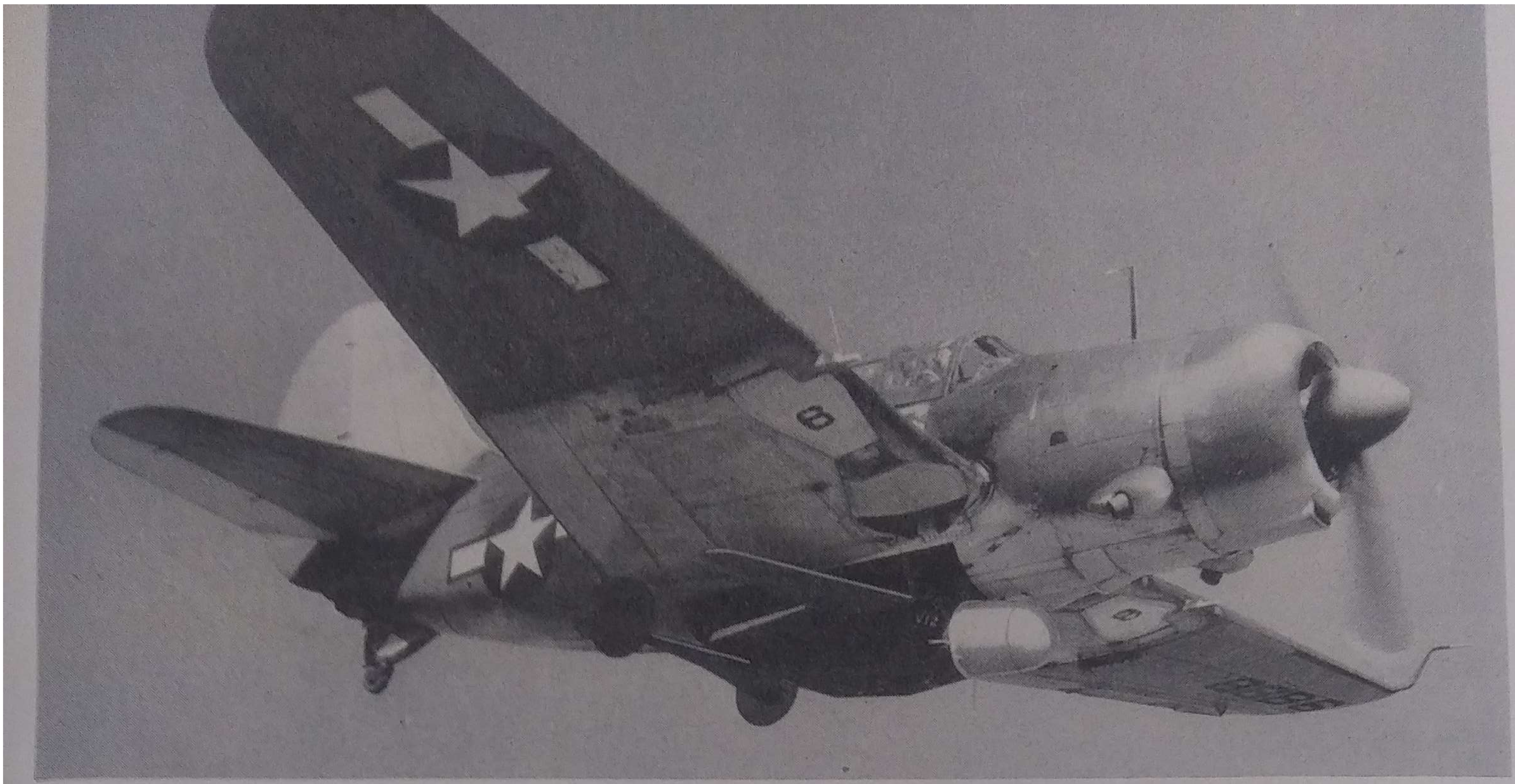

Figure 4—BAT Mounted on SB2C–1C.

of aircraft are suitable, with field modifications, for carrying it: PB4Y–2*, PBY5–A*, PBM–3*, PBJ*, PV–1*, F4U*, SB2C*, TBF*, PBN, F7F, TBM. Figure 3 shows a BAT mounted on the wing of a PB4Y–2, and Figure 4 is a view of one on the SB2C.

7. PUBLICATIONS AND FILMS

a. Publications which have been prepared on components of SWOD (Special Weapon) Mk 9 and associated equipment are:

OP No.	NavAer No.	Title	Description
688	Co-Navaer 16–30 DPN 1–500.	SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN–1) (Preliminary). CONFIDENTIAL.	Describes the operation, maintenance, and testing of the radar used in the BAT.
688	Co-Navaer 16–30 DPN 1–500.	SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN–1) (First Revision) CONFIDENTIAL.	Same as preliminary book, with the exception that it includes information on several modifications. It is a more complete book than the preliminary book.
687	Co-Navaer 16–30 APA 67–500.	Monitor Mk 3 Mod 0 (Control Group AN/APA–67) and Associated Equipment. CONFIDENTIAL.	Describes the installation, adjustment, operation, circuit, theory, and maintenance of the Monitor Mk 3 Mod 0 (Control Group AN/APA–67). The equipment is located in the parent aircraft and is designed for remotely monitoring *one* SWOD (Special Weapon) Mk 9.
1648	Co-Navaer 16–30 APA 66–500.	Monitor Mk 2 Mod 2 (Control Group AN/APA–66) and Associated Equipment. CONFIDENTIAL.	Describes equipment similar to that described in OP 687. The Monitor Mk 2 Mod 2 (Control Group AN/APA–66) is used for remotely monitoring *two* SWOD (Special Weapons) Mk 9.

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*Used as parent aircraft in BAT development tests.

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OP No.	NavAer No.	Title	Description
689	Co-Navaer 16–30 APA 65–500.	Monitor Mk 2 Mod 1 (Control Group AN/APA–65) and Associated Equipment. CONFIDENTIAL.	Describes equipment necessary for remotely monitoring *three* SWOD (Special Weapons) Mk 9.
*1649		SWOD (Control System) Mk 18 Mod 1 (Flight Control Servo PU–146/-DPN–2. CONFIDENTIAL.	Describes the installation, adjustment, operation and circuit theory of the SWOD (Control System) Mk 18 Mod 1 which is used with SWOD (Special Weapon) Mk 9 Mod 1.
1706	Co-Navaer 16–35 SN 48–500.	*Range Unit (Coordinator)* Mk 9 Mod 0 (SN–48/AP) CONFIDENTIAL.	Describes the installation, adjustment, operation, and circuit theory of Range Unit Mk 9 Mod 0. The Range Unit (Coordinator) Mk 9 Mod 0 is a piece of auxiliary equipment which is used by the APS–15 search radar operator to designate to the BAT operator the target that has been selected for attack.
NAMU Report NO–R–0029		Special Equipment Installation. SWOD Mk 9 Mod 0 and Mod 1, PB4Y–2 Airplane.	A report prepared for use in modifying the PB4Y–2 aircraft for use in launching the SWOD Mk 9. No technical information is included.

b. Films which are beneficial for training personnel on the BAT are listed below:

BuOrd No.	Title
MN9041	*SWOD (Special Weapon) Mk 9 Mod 0* (The BAT)—a report film.
MN6482	*SWOD (Special Weapon) Mk 9 Mod 0.* A training film in two parts. Part I is entitled "Loading and Ground Check" and Part II is "Flight Operations".

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* Will have a Co-NavAer number.

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Chapter 2

GENERAL DESCRIPTION

1. COMPONENT UNITS

a. SWOD (Special Weapon) Mk 9 Mod 0 (BAT-0):

SWOD (Air Stabilizer) Mk 13 Mod 0.

SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1).

SWOD (Servo) Mk 4 Mod 4 (Flight Control Servo PU-146/DPN-1).

SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN-75/DPN-1).

SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP-284/DPN-1).

1000-pound General Purpose Bomb AN-M-65.

Special Bomb Fuzes Mk 235 and Mk 236.

Exide Storage Batteries, Type 7-TAS-9E.

(14-volt, three batteries for each missile.)

The physical location of the above units in the missile is shown in Figures 5 and 6.

b. Modifications necessary for the improvement of SWOD (Special Weapon) Mk 9 Mod 0 (BAT-0):

(1) Minimum Range Modification Kit.

(2) Differential Amplifier Modification Kit.

> Note: Complete instructions for installation and tests with circuit diagrams, etc. of the two above Modification Kits may be found in the Appendix of OP 688, SWOD (Radar) Mark 2 Mod 1 (Radar Set AN/DPN-1) First Revision.

(3) Tail Elevator Modification Kit. Instructions concerning this modification may be found in the Appendix B.

c. SWOD (Special Weapon) Mk 9 Mod 1 (BAT-1):

SWOD (Air Stabilizer) Mk 13 Mod 1.

SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2).

SWOD (Control System) Mk 18 Mod 1 (Flight Control Servo PU-146/DPN-2).

SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP-285/DPN-2).

1000-pound General Purpose Bomb AN-M-65.

Special Bomb Fuzes Mk 235 and Mk 236.

Exide Storage Batteries, Type 7-TAS-9E.

(14-volt, three batteries for each missile).

These units as mounted in the air stabilizer are shown in Figures 7 and 8.

d. Modifications necessary to convert the SWOD Mark 9 Mod 0 to a Mod 1 (BAT-0 to BAT-1):

(1) SWOD (Control System) Mk 18 Mod 1 (Flight Control Servo PU-146/DPN-2).

(2) Minimum Range Modification.

(3) Power Supply Modification.

(4) Directional Control Modification.

> Note: Instructions for installing and testing the three above modification kits may be found in OP 688, SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) First Revision.

(5) Fuselage Modification. Instructions for this installation may be found in the Appendix B.

e. Additional modifications necessary for the improvement of both the SWOD Mk 9 Mod 0 and SWOD Mk 9 Mod 1 (BAT-0 and BAT-1):

(1) Removal of Demolition Brackets.

(2) Installation of New Magnetron Chucks.

(3) Change C 203 (Slewing Range) to a 2400 Micro-micro Farad, mica ±10%, 400-volt, DC Capacitor.

(4) Change R 316 (IF Gain) from 500 ohms to 2000 ohms. This is a modification of the AVC.

(5) Installation of Pressurized Beat Oscillator.

(6) Commutator Brush Holes. Sets with serial numbers 1 to 1355 must be drilled out; 1356 to 2301 are drilled and from #2302 will have brass bushings.

(7) Sets under serial number 450 are not equipped with a Range Switch Chassis (all cabling is installed).

(8) Glyptol under side of sockets on units under number 1350.

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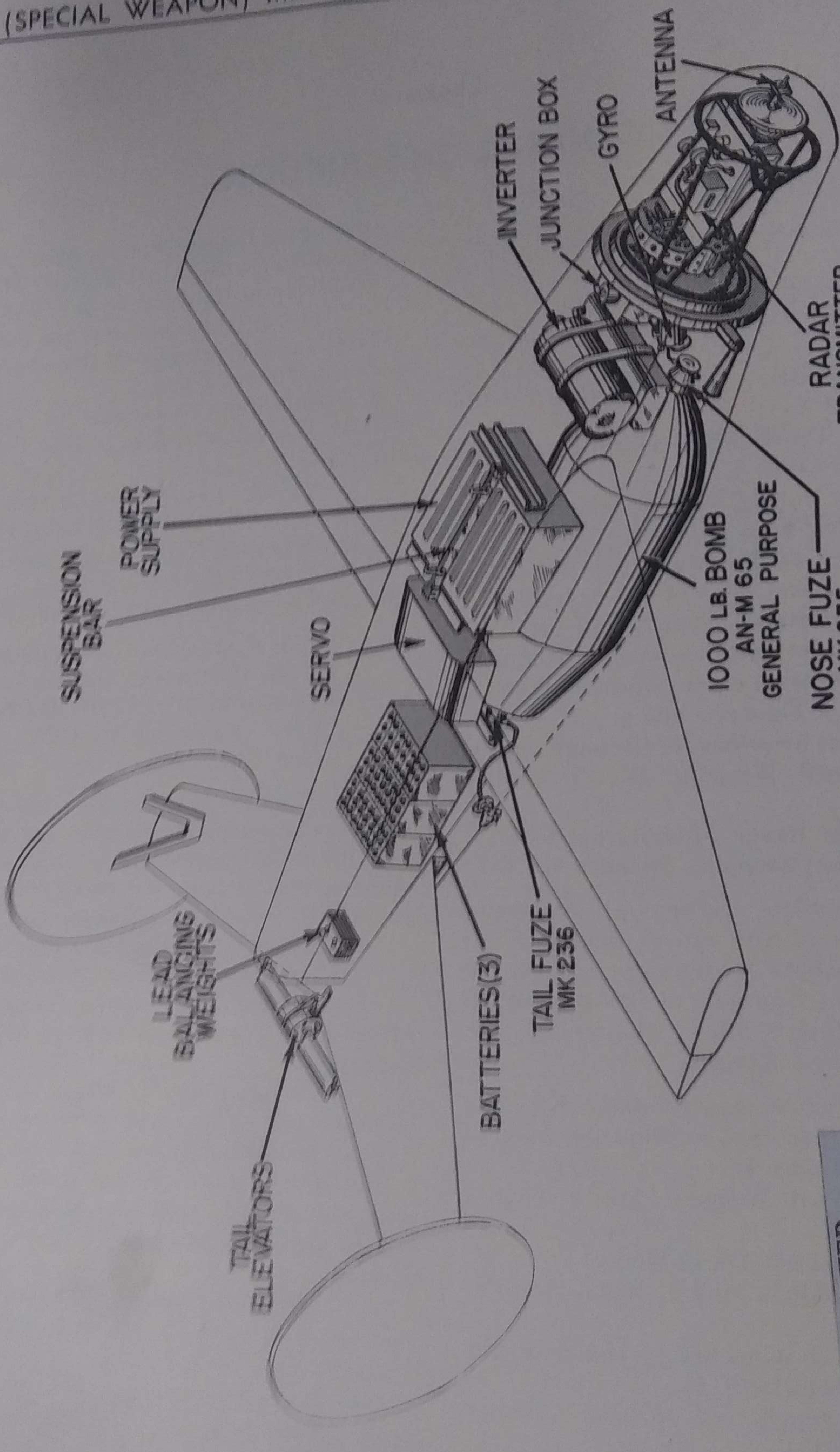

Figure 5—Components of SWOD Mk 9 Mod 0.

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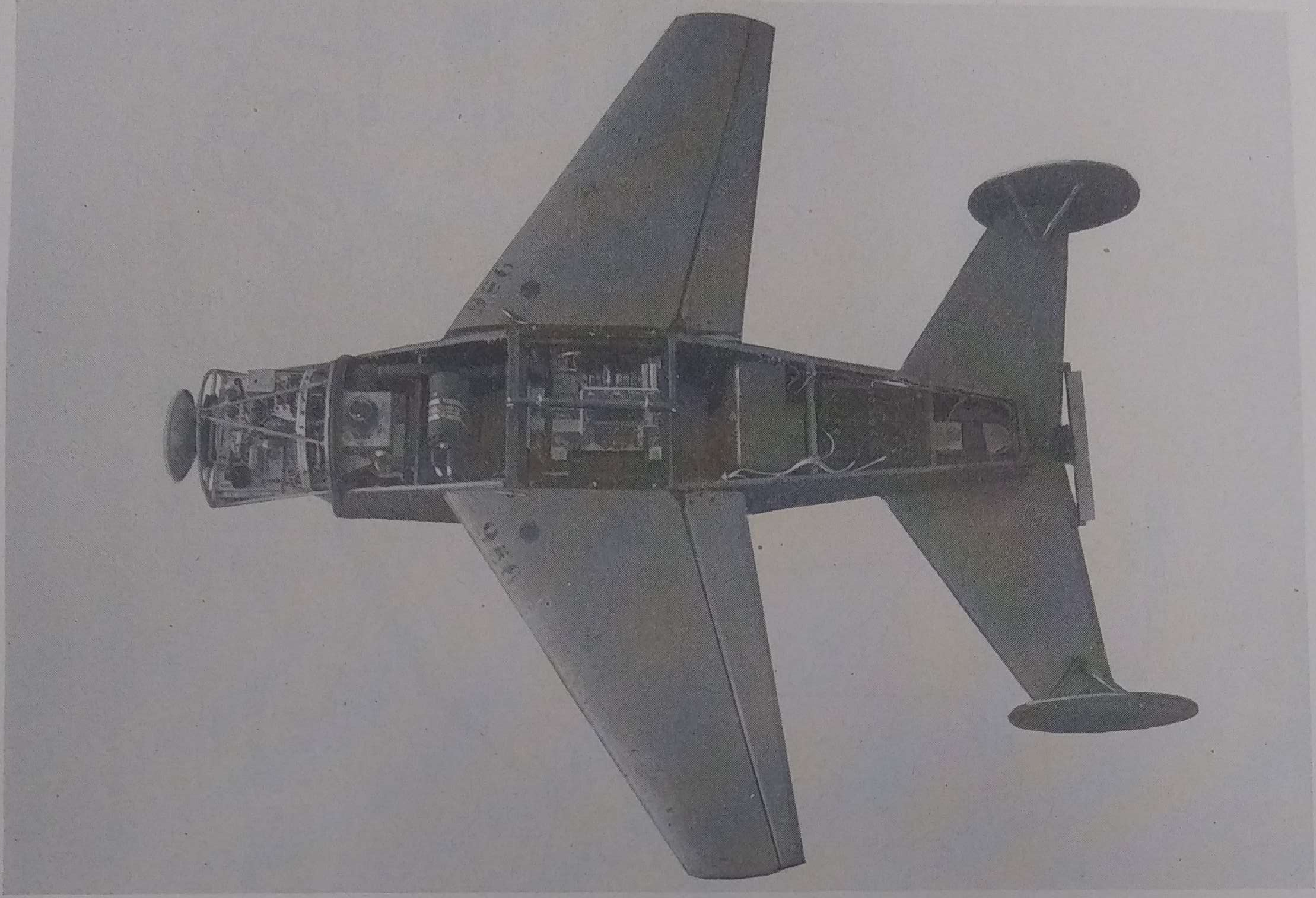

Figure 6—SWOD Mk 9 Mod 0, Components Exposed.

2. THEORY OF OPERATION

A block diagram showing the connections of the various elements of SWOD (Special Weapon) Mk 9 Mod 0 and Mod 1 with the aircraft control equipment is shown in Figure 9.

In SWOD Mk 9 Mod 0 the basic flight control of the air stabilizer is accomplished by two rate gyros (a pitch gyro and a turn gyro) which close and open contacts, operating the clutches of the servo. These air-driven gyros are powered by a Venturi tube projecting into the air stream. Since the rate gyros would normally tend to maintain the original launching course of the vehicle, homing accuracy is obtained by modifying this course by means of directional signals from the radar equipment. A third gyro, designated bias gyro, which is sensitive to yaw motion only, is included in the gyro panel for the purpose of effecting a damping of yaw oscillations or hunting.

A self-contained S-band radar transmitter and receiver is utilized to illuminate the selected target and to receive the returning echoes from it. The transmitter radar pulses from the antenna are directed by the rotating parabolic reflector so that the beam scans a cone-shaped area directly ahead of the missile. The returning target echoes are received by the same antenna and the amplitude of the returning echoes varies with the directional pointing of the antenna beam. The returning target echoes are distributed by a commutator, mechanically coupled to the parabolic reflector, to four channels so that as the antenna beam is pointed down, right, up, or left, the returning echoes are segregated by quadrants. The echoes in each quadrant are converted by the directional control circuit of the radar into a direct current voltage which is proportional to the amplitude of the echoes in that quadrant. In

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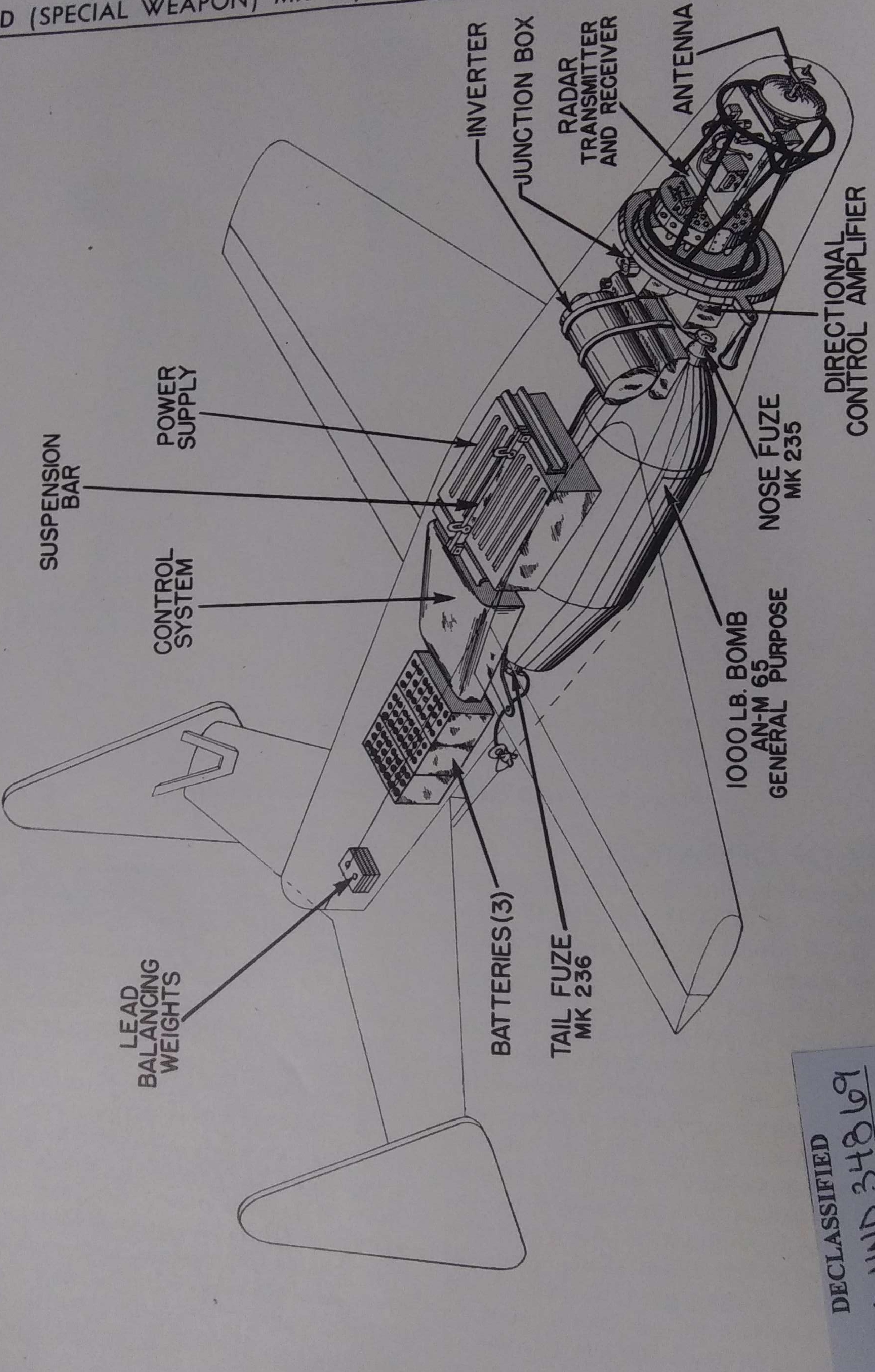

Figure 7—Components of SWOD Mk 9 Mod 1.

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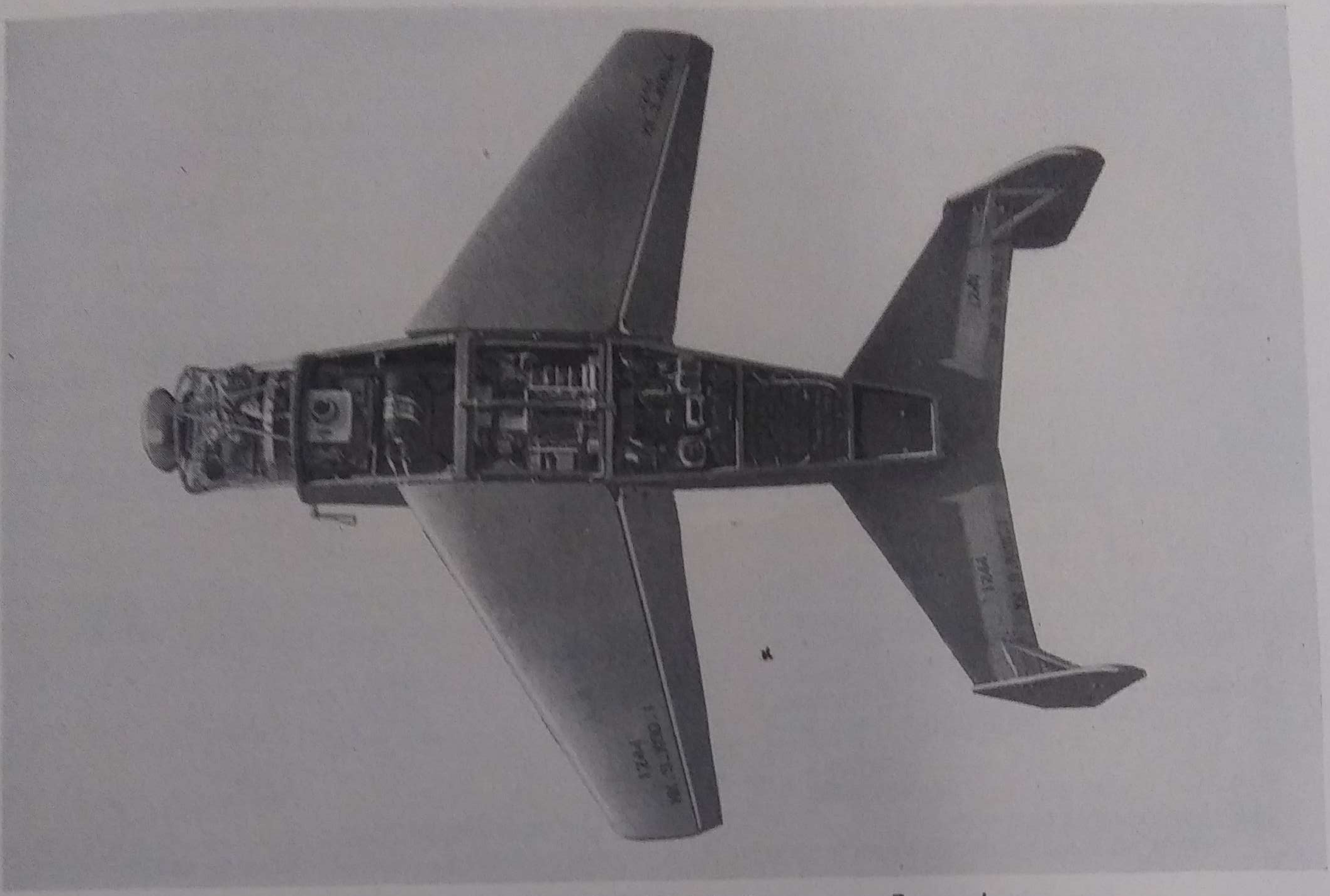

Figure 8—SWOD Mk 9 Mod 1, Components Exposed.

other words, the echoes in opposite quadrants are compared and produce differential currents proportional to the error angle. As the antenna beam is pointed down, right, up, or left by the rotation of the parabolic reflector, the four direct current voltages developed indicate the position of the target with respect to the antenna, or with respect to the axis of the air stabilizer. Should the target be to the right of the flight path of the air stabilizer, the voltage developed in the right quadrant channel would be of larger amplitude than that in the left because of greater intensity of the returning echoes of the right quadrant. When the flight path is directly toward the target the echoes in each quadrant will be of the same amplitude and the voltage of each quadrant channel will be equal. Thus the four channel output of the radar unit indicates the direction of the target with respect to the flight path of the air stabilizer. An automatic gain control circuit keeps the receiver output constant in amplitude during automatic tracking and thus prevents the overloading of the receiver by large echoes as the BAT nears the target.

There is incorporated in the radar unit a target selector circuit which provides for target selection in range, automatic target tracking, and continuous tracking during short intervals when target echo fading occurs. Target selection in range is accomplished by means of a range gate which is approximately 115 yards wide and which can be manually slewed on or off the desired target. Only those echoes returning at the time of this gate can proceed through the remaining circuits and provide directional control to the air stabilizer. Signals from targets at any other ranges have no effect on control. Thus sharp target discrimination in range is obtained. Manual slewing of the range gate is accomplished by the operator at the monitoring equipment in the parent plane prior to

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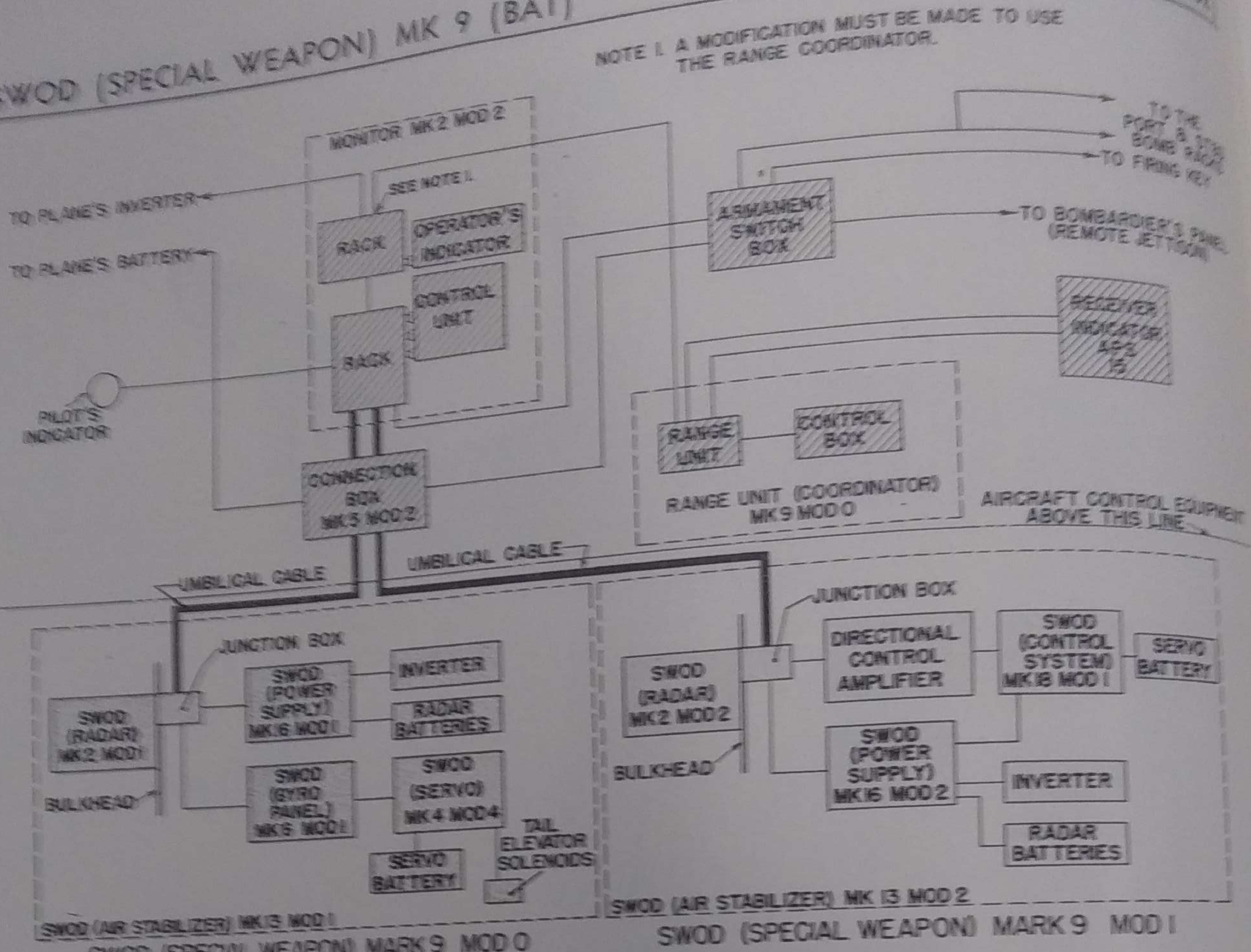
NOTE I. A MODIFICATION MUST BE MADE TO USE THE RANGE COORDINATOR.
MONITOR MK 2 MOD 2
SEE NOTE I.
TO PLANE'S INVERTER
TO PLANE'S BATTERY
RACK
OPERATOR'S INDICATOR
CONTROL UNIT
RACK
PILOT'S INDICATOR
CONNECTION BOX MK 5 MOD 2
ARMAMENT SWITCH BOX
TO THE PORT & STBD BOMB RACK
TO FIRING KEY
TO BOMBARDIER'S PANEL (REMOTE JETTISON)
RECEIVER INDICATOR APS 15
RANGE UNIT
CONTROL BOX
RANGE UNIT (COORDINATOR) MK 9 MOD 0
AIRCRAFT CONTROL EQUIPMENT ABOVE THIS LINE
UMBILICAL CABLE
UMBILICAL CABLE
JUNCTION BOX
SWOD (RADAR) MK 2 MOD 1
SWOD (POWER SUPPLY) MK 6 MOD 1
INVERTER
RADAR BATTERIES
SWOD (GYRO PANEL) MK 6 MOD 1
SWOD (SERVO) MK 4 MOD 4
TAIL ELEVATOR SOLENOIDS
SERVO BATTERY
BULKHEAD
SWOD (AIR STABILIZER) MK 13 MOD 1
SWOD (SPECIAL WEAPON) MARK 9 MOD 0
JUNCTION BOX
SWOD (RADAR) MK 2 MOD 2
DIRECTIONAL CONTROL AMPLIFIER
SWOD (CONTROL SYSTEM) MK 18 MOD 1
SERVO BATTERY
SWOD (POWER SUPPLY) MK 16 MOD 2
INVERTER
RADAR BATTERIES
BULKHEAD
SWOD (AIR STABILIZER) MK 13 MOD 2
SWOD (SPECIAL WEAPON) MARK 9 MOD I

Figure 9—Interconnecting Diagram, SWOD Mk 9 and Aircraft Control Equipment.

the dropping of the BAT. Automatic tracking of the target echo by the range gate is provided to track the target regardless of the maneuvering of either the missile or the target. Should target echoes fade momentarily, the memory feature provides for continuous tracking by the range gate at the tracking rate established and the range gate again brackets the target echoes when they return. Complete fade-out of the echoes is unlikely, but this memory feature provides for such a condition and also acts as a stabilizer to give smoother tracking.

The four signal channels of the radar are connected to four electromagnetic biasing coils in the gyro panel which modify the control action of the rate gyros. In each gyro the coils are so mounted that the electromagnetic pull exerts a force on the gyro gimbal frame to overcome the precessional force of the gyro in order to direct the flight path of the missile toward the target. The mechanical action of the gyro, however, prevents the rate of change of course from exceeding safe flight limits. Should these be approached, the mechanical torque of the gyro overcomes the electromagnetic bias and opens the servo control contact.

The right-left and up-down signal input contacts of the gyro panel control the action of four corresponding solenoids of the servo. Each solenoid, when operated, pulls a gear into position so that the continuously rotating electric motor drives the servo gear train and linkage in the proper direction for the required change in course. The servo linkage is a pantograph device which provides the correct translation motion to the elevon control rods for flight control. This linkage is so designed that in response to up or down signals both servo arms are moved an equal amount in the same direction and in response to right or left signals both the arms are moved an equal amount differentially. Motion in both the up-down and

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right-left channels is provided for simultaneously in this linkage.

The complete missile is suspended from the parent plane by means of a special bomb frame equipped with a standard bomb release unit such as Bomb Rack Mk 51 Mod 7 (see Figure 10). Sway braces are provided to keep the missile in a fixed position on the plane until release. The bomb fuzes are mechanically armed after release by air vanes attached to the fuselage of the air stabilizer. Arming wires attached to the bomb rack release the air vanes at the time of drop-away in the conventional manner.

In SWOD (Special Weapon) Mk 9 Mod 1 (BAT-1) a combined gyro servo control unit designated as SWOD (Control System) Mk 18 Mod 1 (PU-146/DPN-2) (see Figure 8) is used. The principal advantage of this control system over the SWOD Mk 9 Mod 0 (BAT-0) (without the modifications for jmprovement) is an increase in the accuracy of the weapon through faster servo action and increased flight stability.

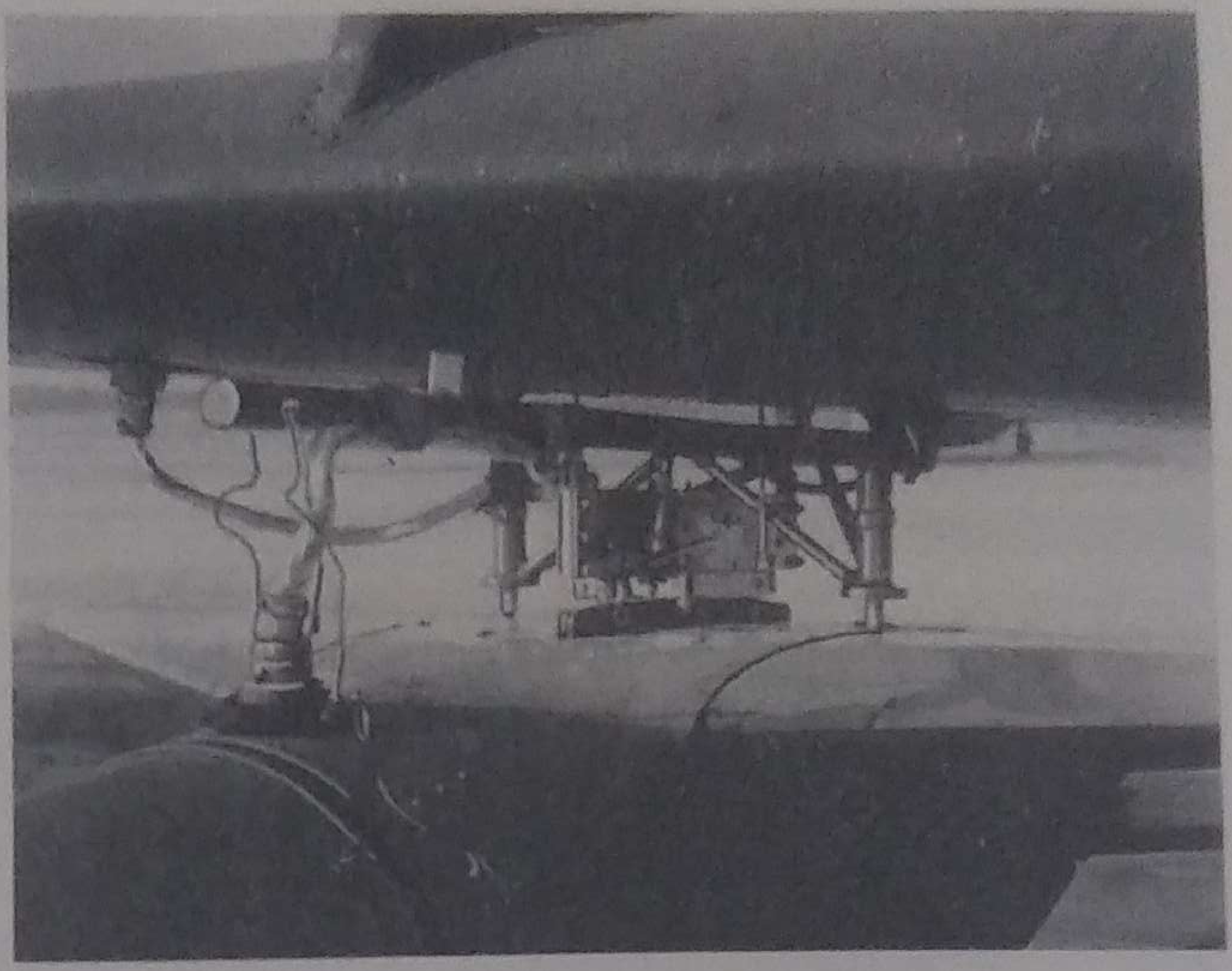

Figure 10—Bomb Rack Mk 51 Mod 7.

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Chapter 3

DESCRIPTION AND OPERATION OF PRINCIPAL PARTS AND SUBASSEMBLIES

1. SWOD (AIR STABILIZER) MK 13 MOD 0 AND MOD 1

a. General Description

SWOD (Air Stabilizer) Mk 13 Mod 0 (Figure 11), is a controllable low-angle-of-flight vehicle of the high monoplane type. It consists of two main wing panels which are mounted separately, the fuselage together with its nose section, and the tail assembly consisting of a horizontal and two vertical stabilizers. These units are constructed principally of molded plywood held fast to the framework by glued joints, screws, nails, and rivets. Steel framework, mounting brackets, plates, and fittings are used at points of high stress.

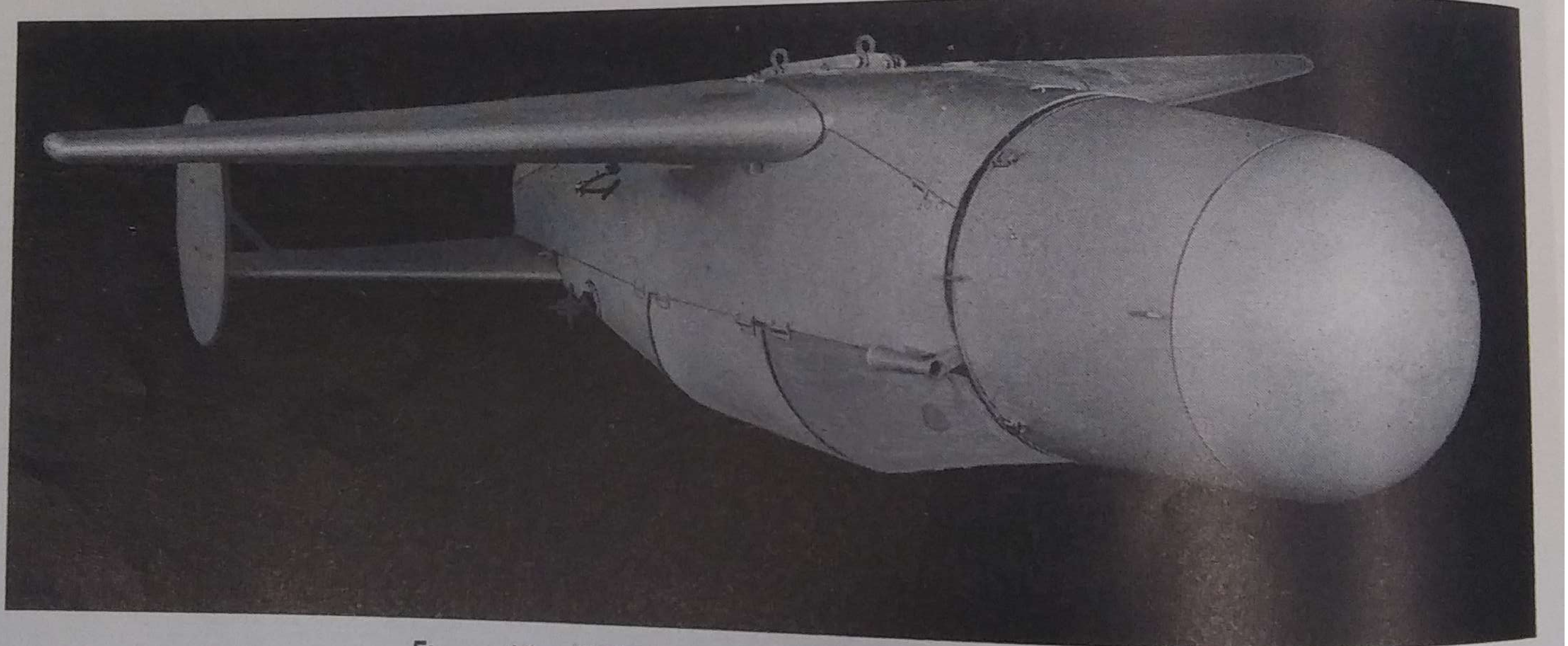

Figure 11—SWOD (Air Stabilizer) Mk 13 Mod 0.

The performance of this air stabilizer is such as to give stable flight well outside the service requirements.

The air stabilizer is designed to be carried by aircraft. A suspension bar with two clevises is attached to the upper surface of the fuselage between the wings so that the complete assembly may be suspended by the clevises from a standard bomb-release unit.

The air stabilizer may be suspended under a wing or below the fuselage of the carrying plane, the arrangement depending upon the type of plane used. Sway bracing is required, the construction depending upon where the air stabilizer is mounted on the plane.

SWOD (Air Stabilizer) Mk 13 Mod 0 is arranged so that the following units may be mounted within the fuselage.

(1) A main removable bulkhead for mounting of gyro and radar equipment. The radar equipment extends forward into the nose and the gyro panel extends aft into the fuselage.

(2) A servo unit to operate the control surfaces (elevons). This unit usually comes installed in the fuselage of the Mod 0.

(3) A power supply and inverter for furnishing power to the radar equipment.

(4) A high explosive pay load. The standard 1,000-pound General-Purpose Bomb AN–M65 is used with suitable fuzes and arming devices.

(5) Batteries to supply power to the inverter and to the control unit.

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b. Detailed Description

The SWOD (Air Stabilizer) Mk 13 Mod 0 is made up of four major sections: the fuselage or body, two wing sections, and the tail assembly. The fuselage or body consists of the fuselage shell, the nose cowling or fairing, the removable bulkhead, and seven fuselage fairings, three on the under side and four on the top side. The wing sections consist of the lift surfaces and the control surfaces or elevons. The tail assembly consists of a horizontal stabilizer and two vertical stabilizers. A recent modification incorporates a tail elevator on the Mod 0. All of these parts are illustrated in Figure 12.

The wing span of the Mod 0 is 120 inches (10 feet) and the over-all length is 143 inches (approximately 11.9 feet). When fully loaded, the total weight of the Mod 0 is approximately 1,600 pounds, of which 1,000 pounds is the bomb load. However, the total weight of the Mod 1 is slightly over 1,700 pounds.

c. Flight Control

All flight control of the SWOD (Air Stabilizer) is effected by the action of the elevons, which in turn are actuated by the servo mechanism or control system. The servo causes angular displacement of the elevons by moving the elevon control rods which transmit motion from the arms of horns attached to the elevons. The angular displacement of the elevons is not necessarily directly proportional to the angular displacement of the servo arms, particularly at the extremes of rotation.

The elevons effect two types of control: control of the glide angle, commonly referred to as glide and dive, and control of the flight path in azimuth, commonly called roll and turn.

GLIDE AND DIVE: Glide and dive are effected

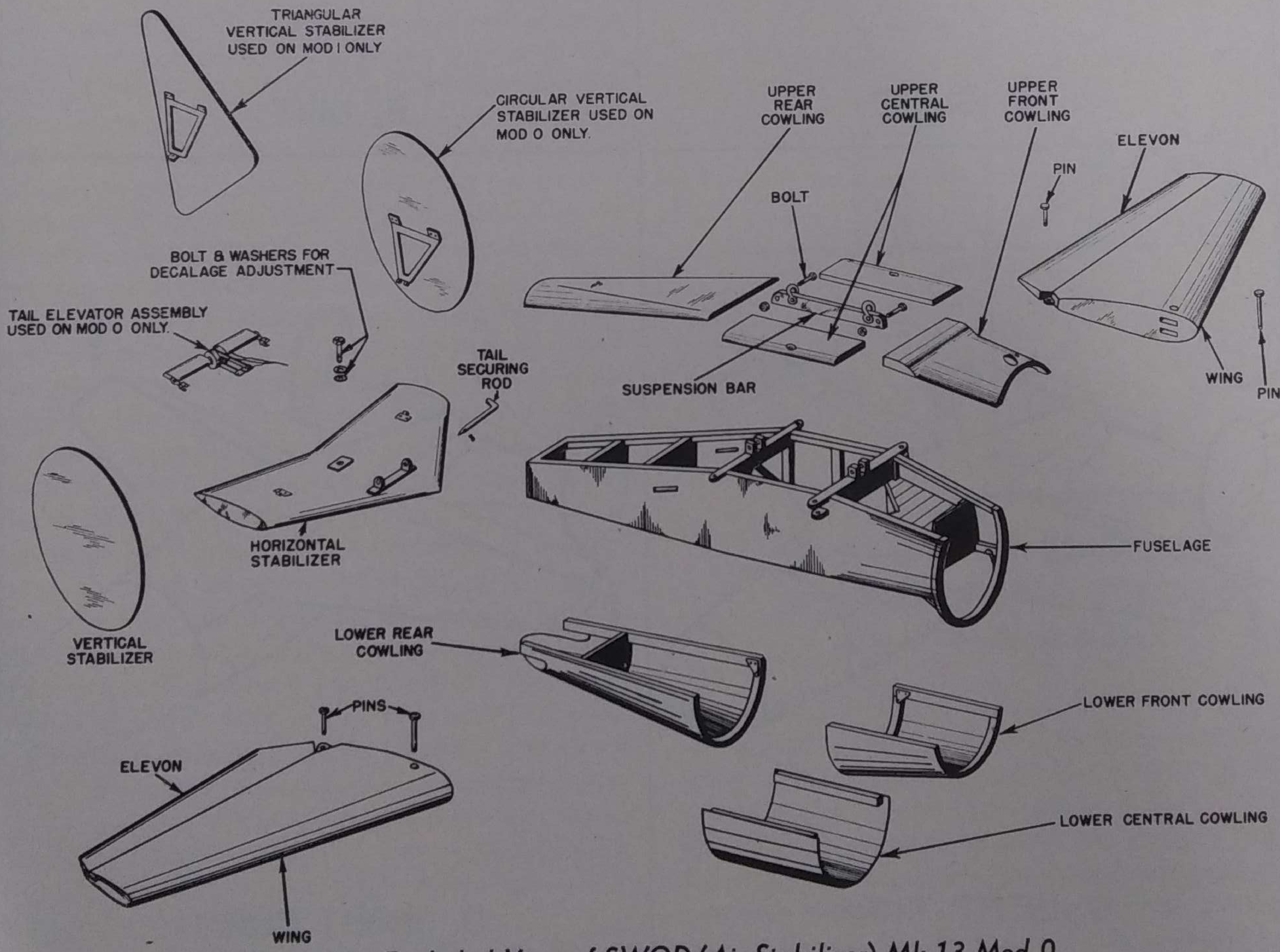

Figure 12—Exploded View of SWOD (Air Stabilizer) Mk 13 Mod 0.

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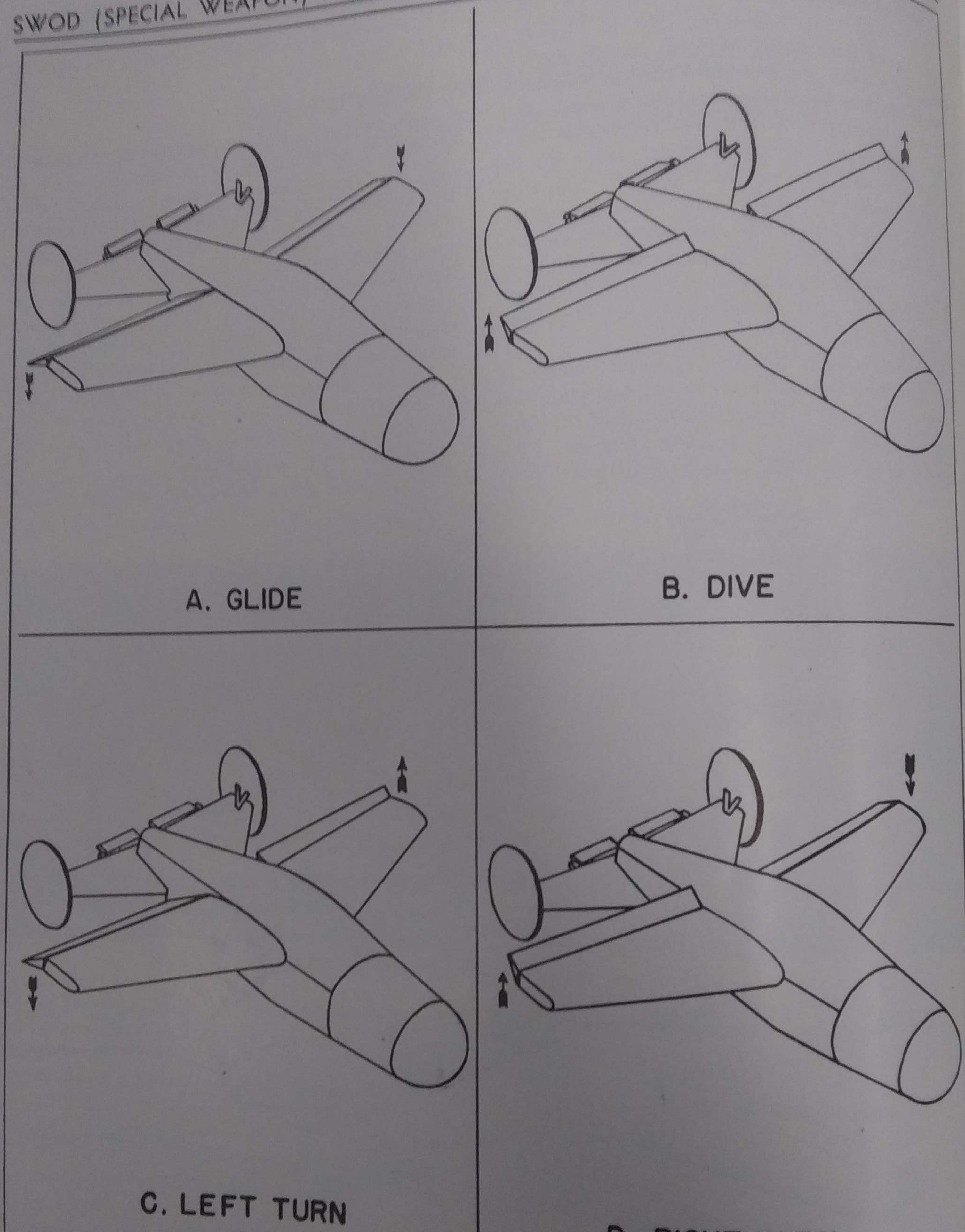

A. GLIDE

B. DIVE

C. LEFT TURN

D. RIGHT TURN

Figure 13—Elevon Positions.

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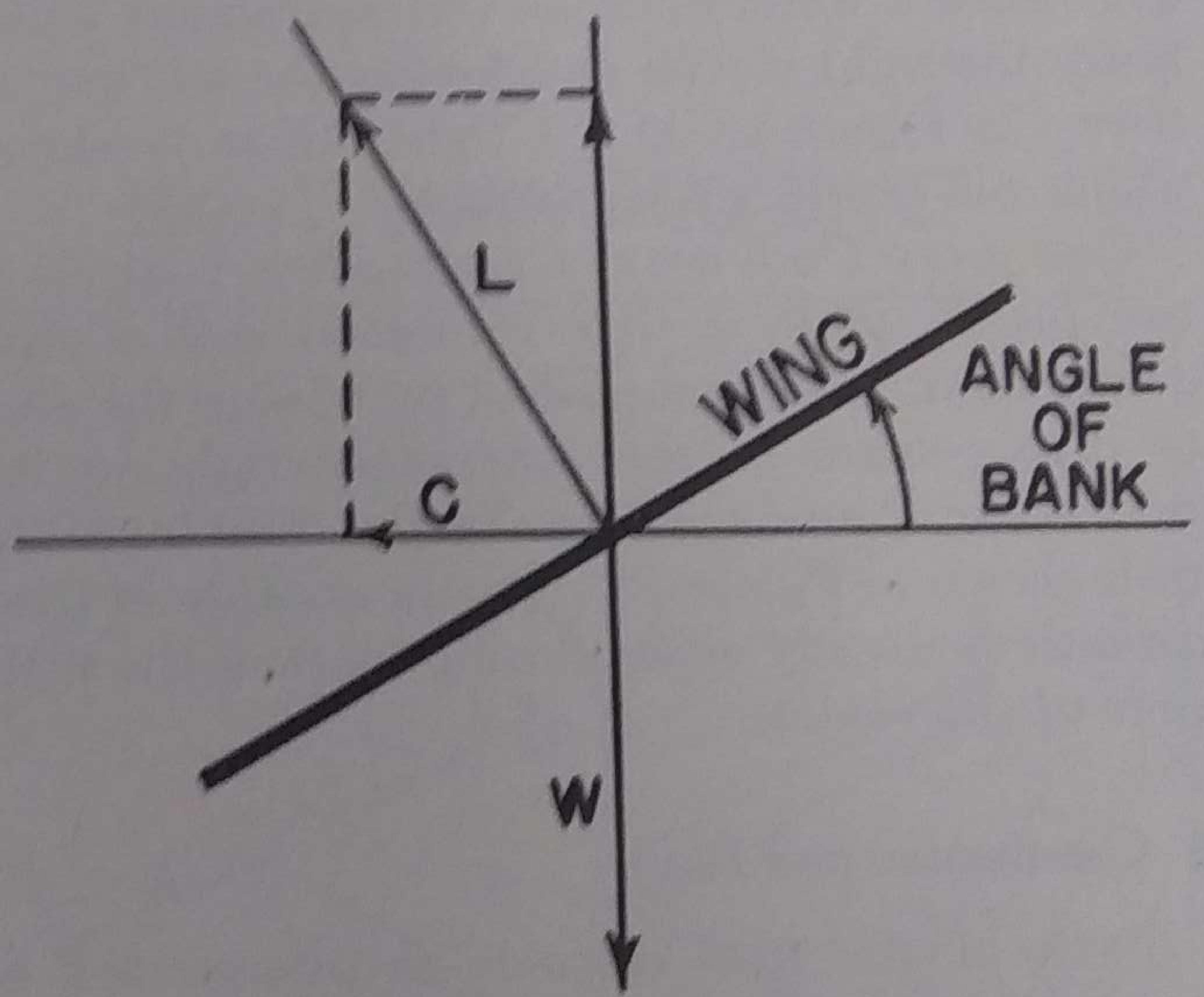
by causing an equal angular displacement of both elevons, resulting in dive when both elevons are rotated upward, and in glide when both elevons are rotated downward. This rotation of the elevons results in a change in lift at any given air speed. Thus, in order for the vehicle to reach stabilization again, it must assume a new glide angle and speed so that the lift again will equal the weight of the vehicle and it can assume a new straight-line glide path.

A glide control is introduced when the servo mechanism lowers both of the elevons an equal amount, as shown in Figure 13-A. This will result in an increased lift which will cause the vehicle to follow a curved upward path and slow down until the vertical component of the lift again equals the weight. The reduction in speed will result in reduced total drag. For a condition of equilibrium, the drag must be just balanced by a force which is the component of the weight existing along the glide path. For reduced drag, a smaller glide angle will supply the necessary balancing force, and equilibrium will be re-established along a new glide path at a lower speed. The range will be increased with a smaller glide angle, since the intersection of the glide path with the earth's surface will be extended. The combination of reduced speed and glide angle will result also in reduced sinking speed.

A dive control is introduced when the servo mechanism raises both of the elevons an equal amount, as shown in Figure 13-B. This will result in a decreased lift which will cause the vehicle to follow a curved downward path and speed up until the vertical component of the lift again equals the weight. The increase in speed will result in increased total drag. For a condition of equilibrium, the drag must be just balanced by a force which is the component of the weight existing along the glide path. For increased drag, a larger glide angle will supply the necessary balancing force, and equilibrium will be re-established along a new glide path at a higher speed. The range will be decreased with a larger glide angle, since the intersection of the glide path with the earth's surface will be diminished. The combination of increased speed and glide angle will result also in increased sinking speed.

ROLL AND TURN: Roll and turn are effected by causing a differential angular displacement of the elevons. When the right elevon is raised and the left elevon is lowered an equal amount, due to the operation of the differential channel of the servo mechanism, the vehicle will rotate or roll in a clockwise direction about its longitudinal axis. This rolling action, which will continue until the elevons are repositioned, is the result of the left wing having greater lift than the right wing. Similarly, when the left elevon is raised and the right one is lowered an equal amount, a roll in the opposite direction results, and will continue until the elevons are repositioned because the right wing will then have greater lift than the left wing.

As the angle of roll or bank is increased, the vertical lift produced by the wings diminishes, and a horizontal component acting at a right angle to the longitudinal axis of the vehicle is introduced. This horizontal component, "C" in Figure 14, is a force which will deflect the vehicle from a straight-line flight, and is called the centripetal force. The magnitude of this centripetal force varies as the tangent of the angle of bank. Thus, the greater the angle of bank, the greater will be the resulting centripetal force, and the shorter the resulting radius of turn. Since the lift produced by the wings decreases as the angle of bank in-



L TOTAL LIFT OF WING
W = WEIGHT OF STABILIZER
C = CENTRIPETAL FORCE

Figure 14—Forces of Turn.

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creases, unless the speed is increased for a given elevon setting, both elevons must be lowered together an equal amount in the glide position to maintain the required lift.

Limits are established to prevent the angle of roll from exceeding certain values to prevent excessive loss of altitude and the possibility of corkscrew rolls developing. Compensation can be made for rolls resulting from vertical air currents by proper use of differential elevon action to produce counter rolls. Errors in azimuth also may be corrected by introducing rolls which will result in turn in the desired direction.

A left turn is introduced by a servo action which will cause a differential elevon movement which raises the left elevon and lowers the right one, as shown in Figure 13–C. This causes a left roll to be developed, resulting in a left turn.

A right turn is introduced by servo action which will cause a differential elevon movement which raises the right elevon and lowers the left one, as shown in Figure 13–D. A right roll is developed which will result in a right turn.

Combined Controls: Combination controls in two planes, glide or dive combined with a right or left turn, are accomplished by adding the glide or dive control to the differential right or left turn control, producing one of the combined controls shown in Figure 15. One or another of these conditions usually exists during most of the flight time of the vehicle.

d. Construction and Finish

Each of the four sections is constructed by molded plywood which is held fast to its framework by glued joints, screws, nails, and rivets. The nose cover unit or fairing is of metal construction with plexiglas tip. All material conforms to A–N specifications and workmanship is in accordance with standard aircraft practices.

A durable finish suitable for field use is applied to all parts in accordance with the following specifications:

Wood finish, outside
  One coat of DuPont paste and wood filler
  Two coats of DuPont RKT–366 clear wood sealer with Shirlan (or equivalent) anti-mold agent added.
  One coat of DuPont 71–19324 lusterless dark sea-gray paint.
Wood finish, inside
  Two coats of DuPont RKT–366 clear wood sealer with Shirlan (or equivalent) anti-mold agent added.
Metal finish
  All hardware—cadmium plated steel or zinc-plated iridite-treated steel.
  All sheet steel, structural steel angles and fittings—zinc plated.

The air stabilizer should be inspected for any damaged or broken parts and if any are located they should be refinished immediately.

Physical Arrangement of Contained Units: The physical arrangement of the units contained within the SWOD (Air Stabilizers) Mk 13 Mod 0 and Mod 1 are shown in Figures 5 and 7, respectively. All of the equipment is enclosed within the plywood cover, except the parts that must project into the windstream, such as the arming vanes, elevon control rods, and elevons.

Fuselage: The fuselage is round in cross section at the removable bulkhead just back of the nose, and flares to a rectangular cross section with rounded top and bottom fairings tapering toward the tail. The removable bulkhead is secured by four bolts to mounting brackets on the fuselage in such a manner that the bulkhead is at right angles to the longitudinal axis of the air stabilizer. Auxiliary equipment is mounted on both sides of this bulkhead (Figure 16). The radar equipment on the forward side of the removable bulkhead is supported by a metal bulkhead which is attached to the fuselage by the same four bolts that secure the wooden bulkhead. The gyro panel is mounted on the after side of the wooden bulkhead.

The nose cover is a smoothly rounded unit attached to the metal bulkhead by four spring fasteners. The nose cover is held against a rubber gasket by these fasteners, thus providing, to some extent, air and water tightness for protection of the equipment within the nose cover.

The shelf located between the main bulkhead and the forward wing beam, and the space between the wing beams above the bomb are used for mounting the inverter and power supply, respectively.

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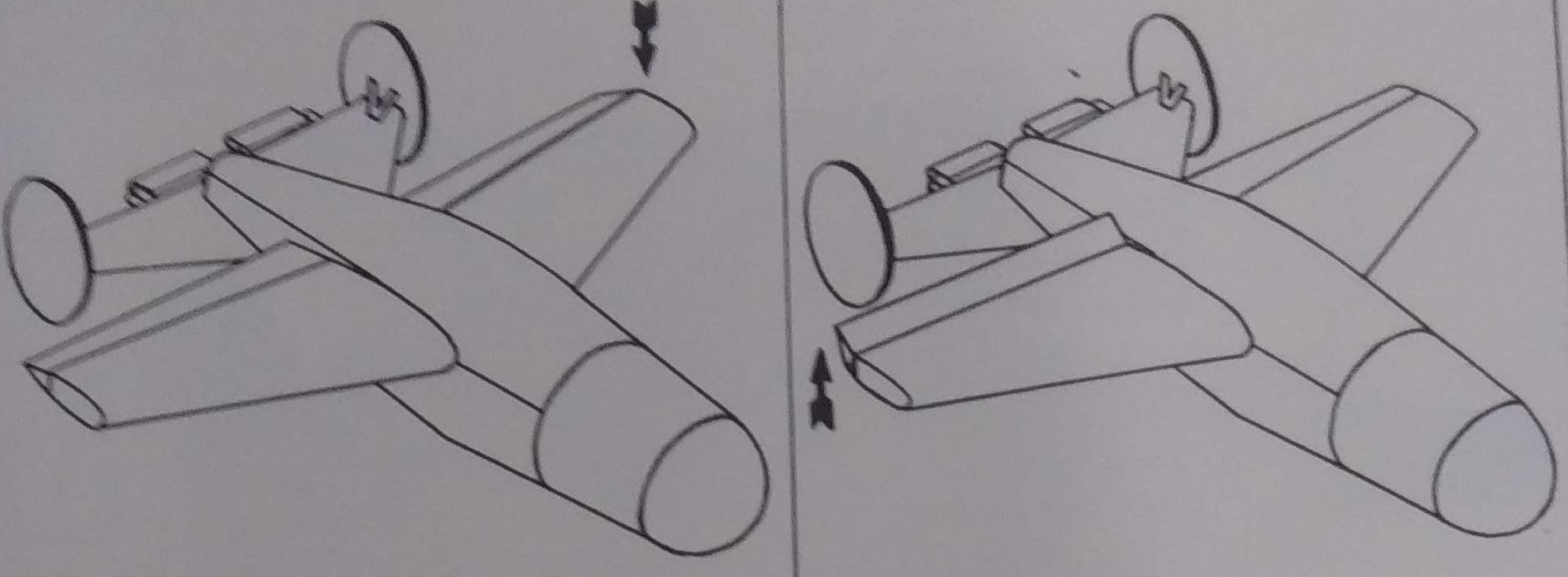
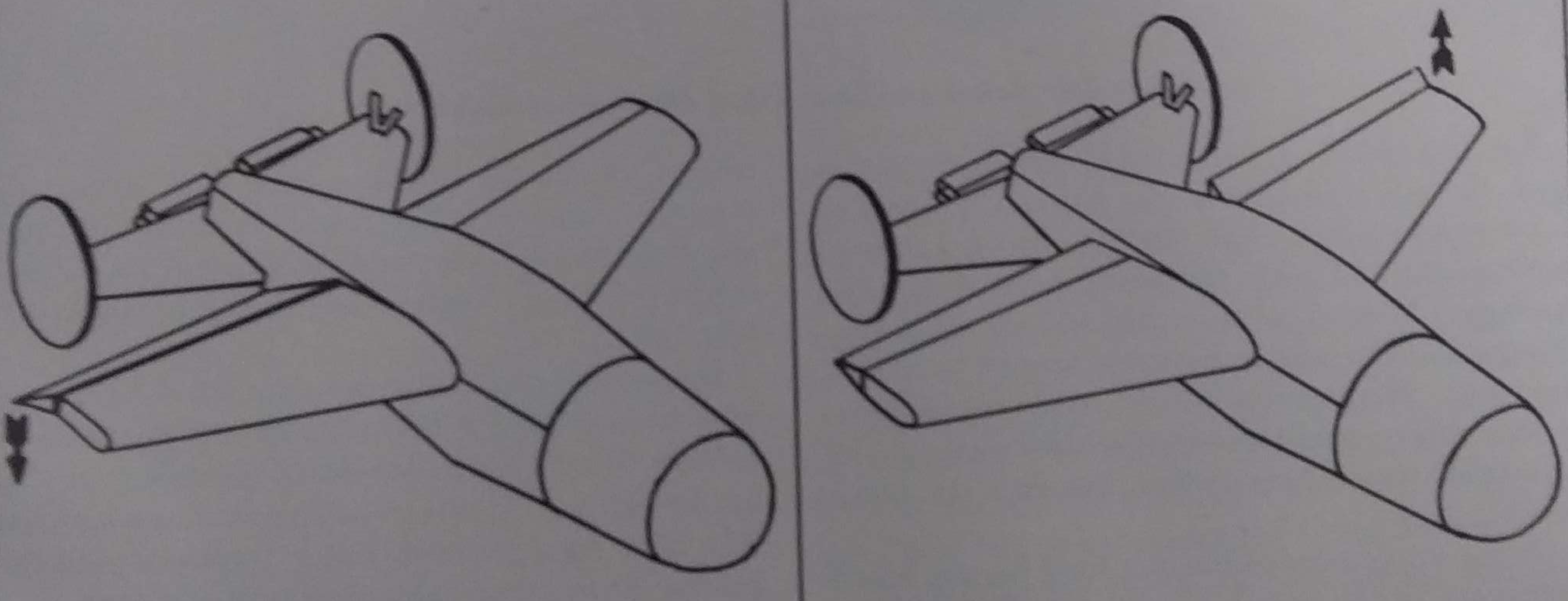


A.
RIGHT TURN AND GLIDE

B.
RIGHT TURN AND DIVE



C.
LEFT TURN AND GLIDE

D
LEFT TURN AND DIVE

Figure 15—Elevon Positions, Combination.

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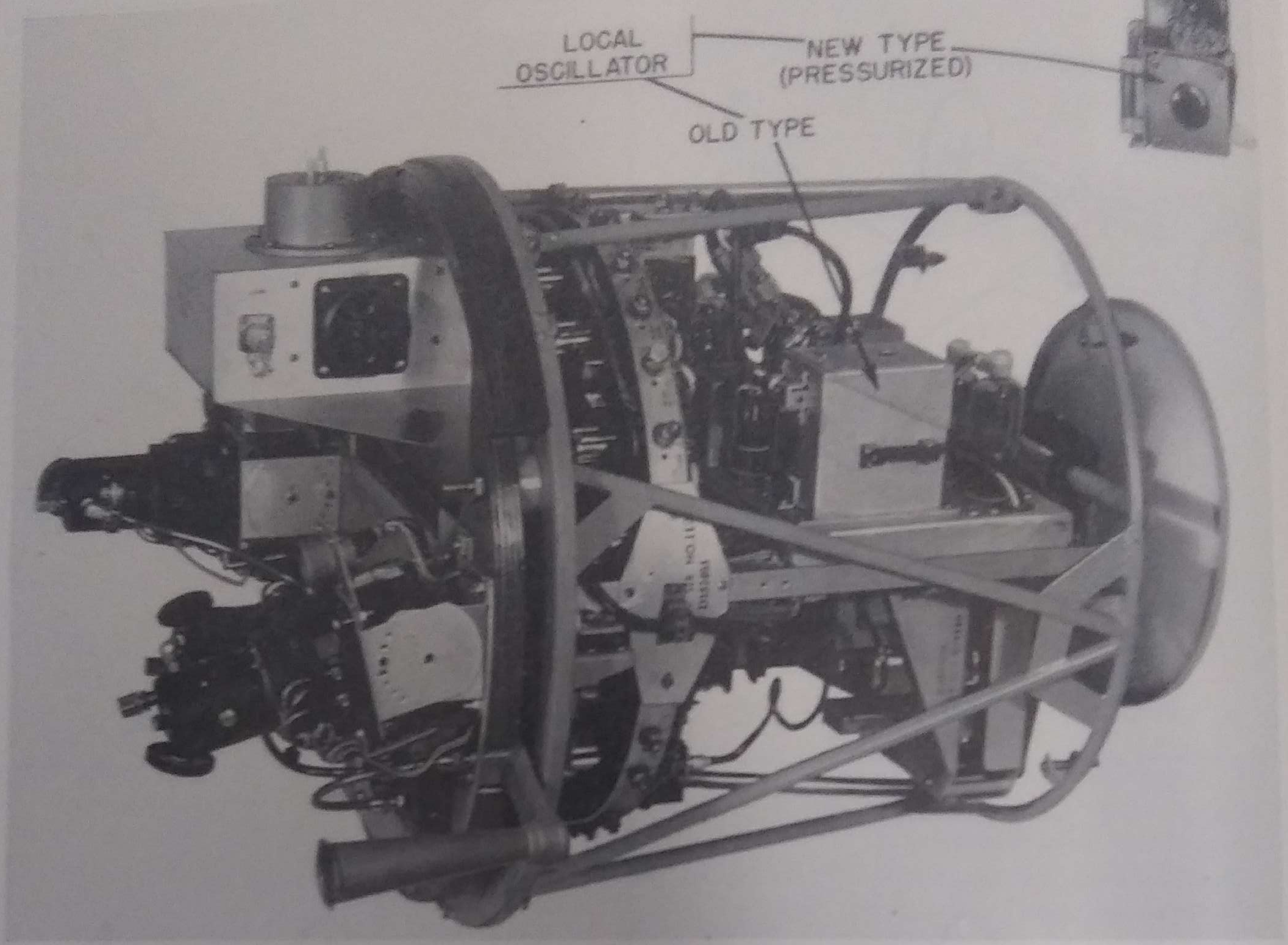

Figure 16—Radar and Gyro Panel Mounted on Bulkhead.

Because of the concentrated weight of the bomb load, the center section of the fuselage consists of a plywood-covered steel frame, the top lateral sections of which form the wing beams within the fuselage. Welded to these beams are wing root fittings through which pins are passed to attach the wings. The bomb is secured to the bomb frame by steel straps, which pass under the bomb, and an adjustable thrust brace which fits over the bomb lugs.

On the upper edge of the two wing beams, which form part of the fuselage center section, attachments are provided to carry the entire load of the air stabilizer by means of a suspension bar having two clevises on it which fit a standard bomb rack.

The servo unit in both the SWOD (Air Stabilizer) Mk 13 Mod 0 and Mod 1 is mounted just behind the metal center section and within the fuselage. The arms of this unit extend through openings in the plywood sides and the elevon control rods are connected to them outside the fuselage.

Behind the servo unit are two fixed bulkheads. The space between these bulkheads is used as a battery box for three seven-cell aircraft-type storage batteries. This wax-impregnated wooden battery box has grooved inside surfaces and has electric heater units mounted in the bottom.

NOTE: Excess wax in the battery box should be removed. If there is an excess of wax, the battery heater may cause the batteries to stick to the bottom. In such a case do not try to lift the batteries out with pliers but use a wide chisel along the sides near the corners and pry out.

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In the lower longerons near the after end of the fuselage are two attachment fittings which are provided for the tail assembly mounting pin. At the extreme after end of the fuselage a third attachment fitting is provided to form a rear point of attachment for the tail assembly, which is bolted at this point.

The upper curved portion of the fuselage is formed by four hatches or fairings. A hatch extending from the main bulkhead to the main wing beam, two fairings between the wing beams (one on each side of the suspension bar) and a hatch covering the top of the fuselage extending from the rear wing beam to the after end of the fuselage.

The under side of the fuselage is completed by three fairings, the first extending from the main bulkhead to a point approximately under the main wing beams, the second covering the under portion of the fuselage approximately under the wings, and the third extending from the end of the second to the tail.

Drainage holes ¼ inch in diameter are drilled along the center line of the fairings or cowlings, as follows: one in the rear cowling just abaft the reinforcing ring, one in the lower front cowling immediately before the reinforcing ring, two in the center cowling at the fore and after ends, respectively.

All hatches and fairings are secured to the fuselage by hinge fittings with removable pins or by special draw latches, with the exception of the two small fairings between the wing beams on the upper side which are bolted to the metal framework.

Wing and Control Surfaces: The detachable wings are of the cantilever type. The wing structure has a symmetrical airfoil, or wing cross section, and a leading edge sweep-back of 33.5 degrees with no dihedral. Each wing is pinned to the fuselage steel center section with two removable steel pins.

The two control surfaces or elevons form the trailing edges of the wing structure. Each elevon is attached to the wing by two metal hinges. A horn, or arm, is provided on the inboard end of each elevon and an elevon control rod is used to link each elevon horn to its servo arm. The elevons should be capable of free upward rotational movement of 60 degrees and a free downward rotational movement of 45 degrees from the neutral position before the elevon control rods are attached.

Tail Assembly: The tail assembly is composed of two vertical stabilizers and a horizontal stabilizer. Refer to Figures 5, 6, 7, and 8. At first there were no movable parts in this assembly. However, in modifying the Mod 0 for improvement of the missile a tail elevator has been added at the center of the trailing edge of the horizontal stabilizer (see Figure 17 also Appendix B). The tail elevators shown in ensuing photographs are the experimental ones and not the production type as shown in Figures 17, 126, and 128. The horizontal stabilizer has a sweep back similar to the main wings but it has a flat airfoil section. The assembly is mounted directly on the lower longerons of the fuselage by a long steel pin and by a bolt at the rear of the fuselage. A reenforcing plate is mounted at the center of the horizontal stabilizer to a rear attachment fitting on the fuselage. Both vertical stabilizers are mounted parallel to the plane of symmetry and have a flat airfoil. On the SWOD (Air Stabilizer) Mk 13 Mod 0 the verticle stabilizers are circular but on one Mod 1 they are triangular. See Figure 18.

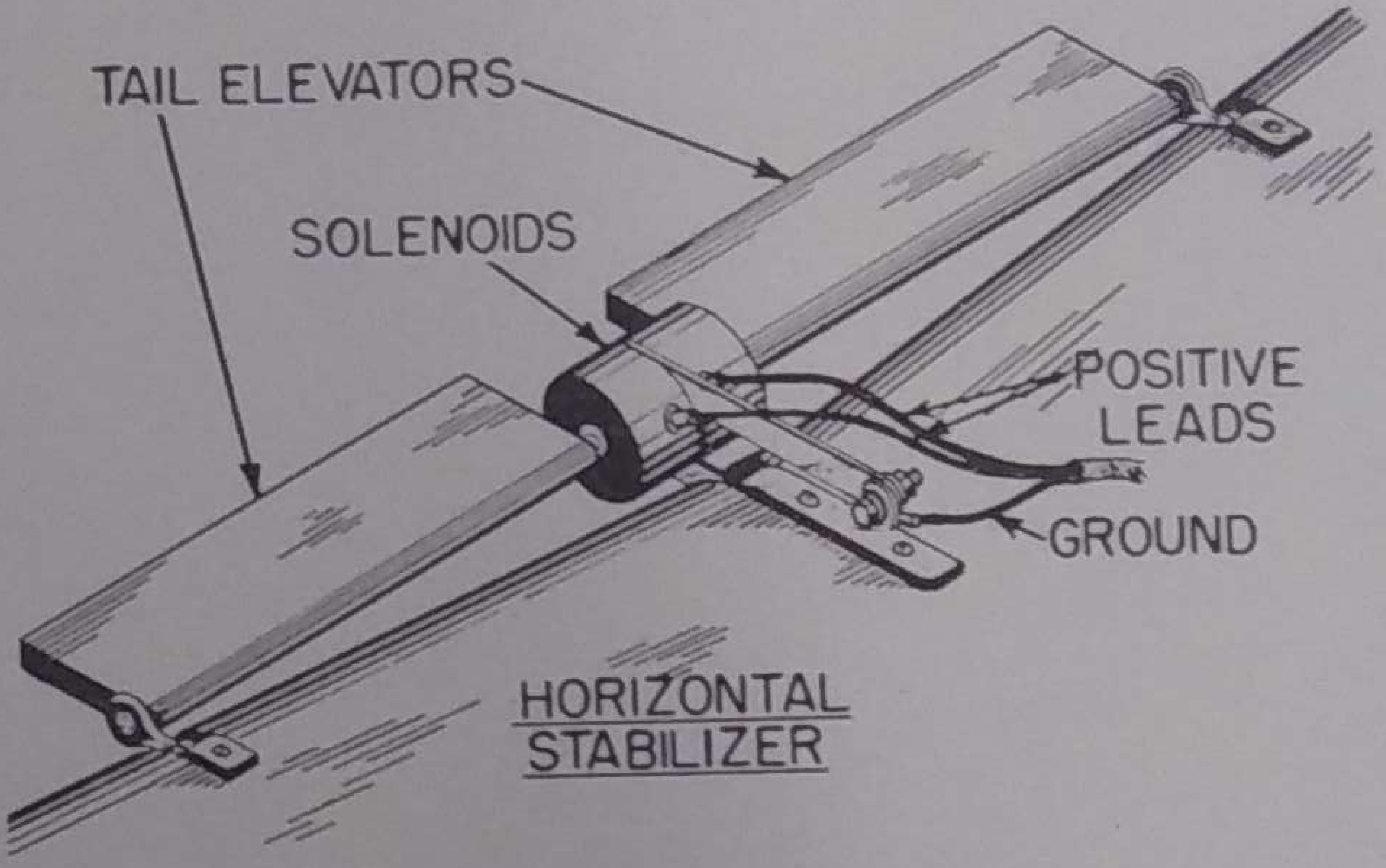

Figure 17—Tail Elevators.

The horizontal stabilizer is mounted with its fore and aft axis or chord line at a negative angle of two degrees (leading edge depressed) with respect to the chord line of the main wing structure. This angle is called the decalage and is critical to the proper flight performance of the air stabilizer.

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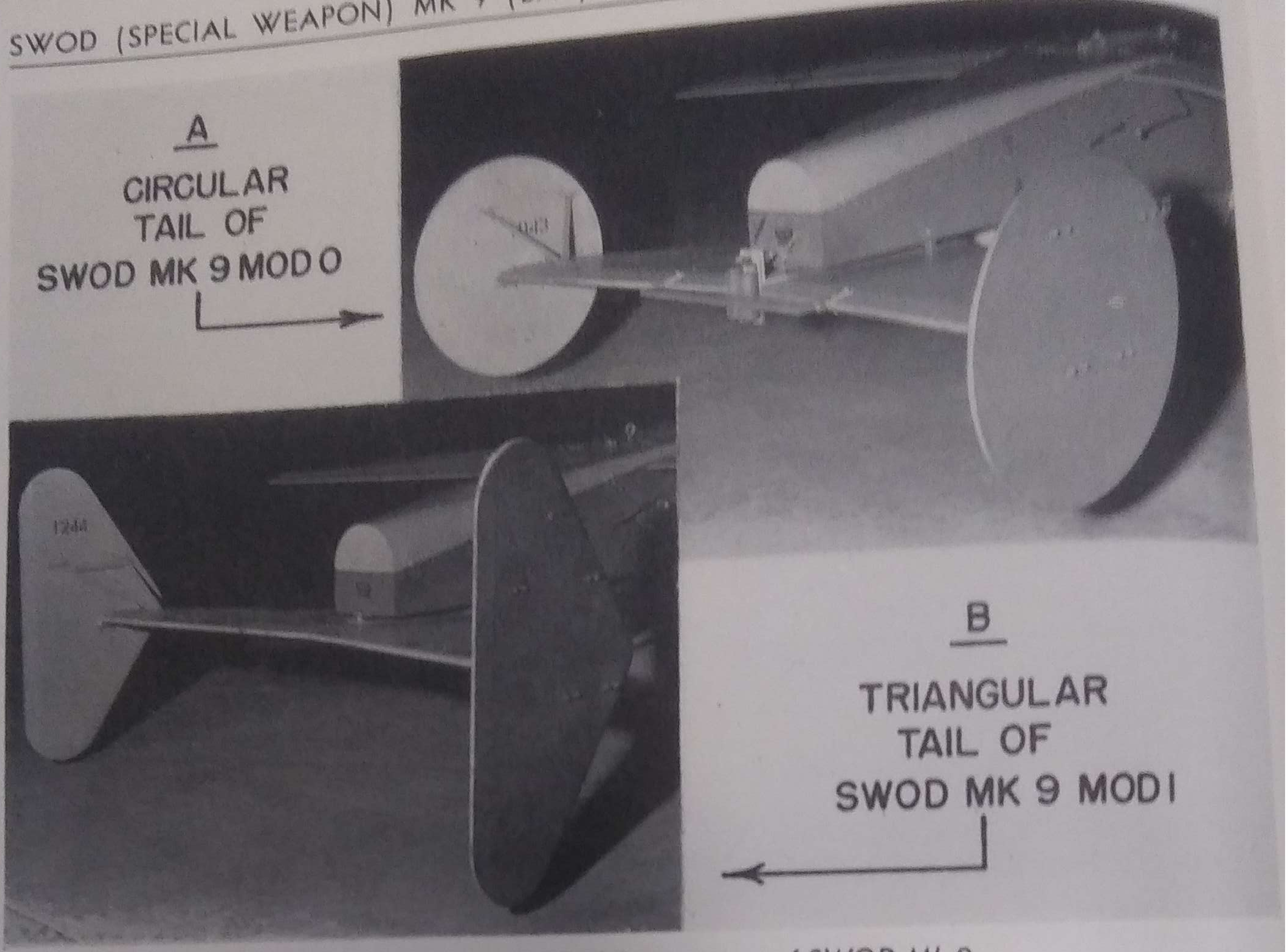
A
CIRCULAR TAIL OF SWOD MK 9 MOD 0
B
TRIANGULAR TAIL OF SWOD MK 9 MOD I

Figures 18A and 18B—Tail Constructions of SWOD Mk 9.

Physical Characteristics: SWOD (Air Stabilizer) Mk 13.

	Mod 0	Mod 1
Over-all length	11.9 ft	12.3 ft.
Wing spread	10 ft	10 ft.
Weight empty (without bomb)	600 lbs	700 lbs.
Pay load	1,000 lbs	1,000 lbs.
Total effective wing area	25.0 sq. ft	25.0 sq. ft.
Area each wing (including elevons)	9.1 sq. ft	9.1 sq. ft.
Total elevon area	3.6 sq. ft	3.6 sq. ft.
Area each elevon	1.8 sq. ft	1.8 sq. ft.
Area horizontal stabilizer	10.3 sq. ft	10.3 sq. ft.
Area of tail elevator	47.5 sq. in	Has none.
Total area vertical stabilizers	6.82 sq. ft	8.0 sq. ft.
Area each vertical stabilizer	3.41 sq. ft	4.0 sq. ft.
Wing loading	64 lbs. per sq. ft	68 lbs. per sq. ft.
Airfoil-wing section	NACA 0015	NACA 0015.
Airfoil-stabilizer section	Flat	Flat.

Flight Characteristics: The following are the approximate average equilibrium air speeds and corresponding glide angles for SWOD (Air Stabilizer) Mk 13 Mod 0 and Mod 1.

Air speed (elevons neutral)	210–240 K (knots).
Air speed (elevons full glide)	170–190 K.
Air speed (elevons full dive)	280–320 K.
Launching speed (elevons neutral)	140–210 K.
Glide angle (elevon neutral)	8°–10°.
Glide angle (elevons full glide)	8°–10°.
Glide angle (elevons full dive)	25°–35°.
Maximum rate of turn (normal turn).	3.6° per second.

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e. Packing, Modifications, and Handling

METHOD OF PACKING: SWOD (Air stabilizer) Mk 13 Mod 0 is packed for shipment in a large specially designed crate to accommodate and protect the various parts. The wings, complete with elevon control rods, and horizontal stabilizer are supported along the sides of the crate by padded wooden clamps (Figure 19). The vertical stabilizers are similarly clamped to the bottom of the crate. The fuselage minus the nose unit but with all fairings and the servo unit in place is hung by its suspension bar from a removable rack that also forms the cross bracing in the middle of the crate (Figure 20.)

Prior to packing, the elevon control rods are adjusted to the proper length and the servo is placed in neutral. All pins and small hardware including the suspension bar devices are placed in a cloth bag which is stowed in the fuselage.

The packing arrangement is designed for all-weather shipment. The top of the crate is waterproofed. The bottom is partially open to permit drainage. Circulation of air is obtained from louvers cut in the sides of the crate and the open bottom. Skids are provided on the bottom of the crate for drainage and ease of handling.

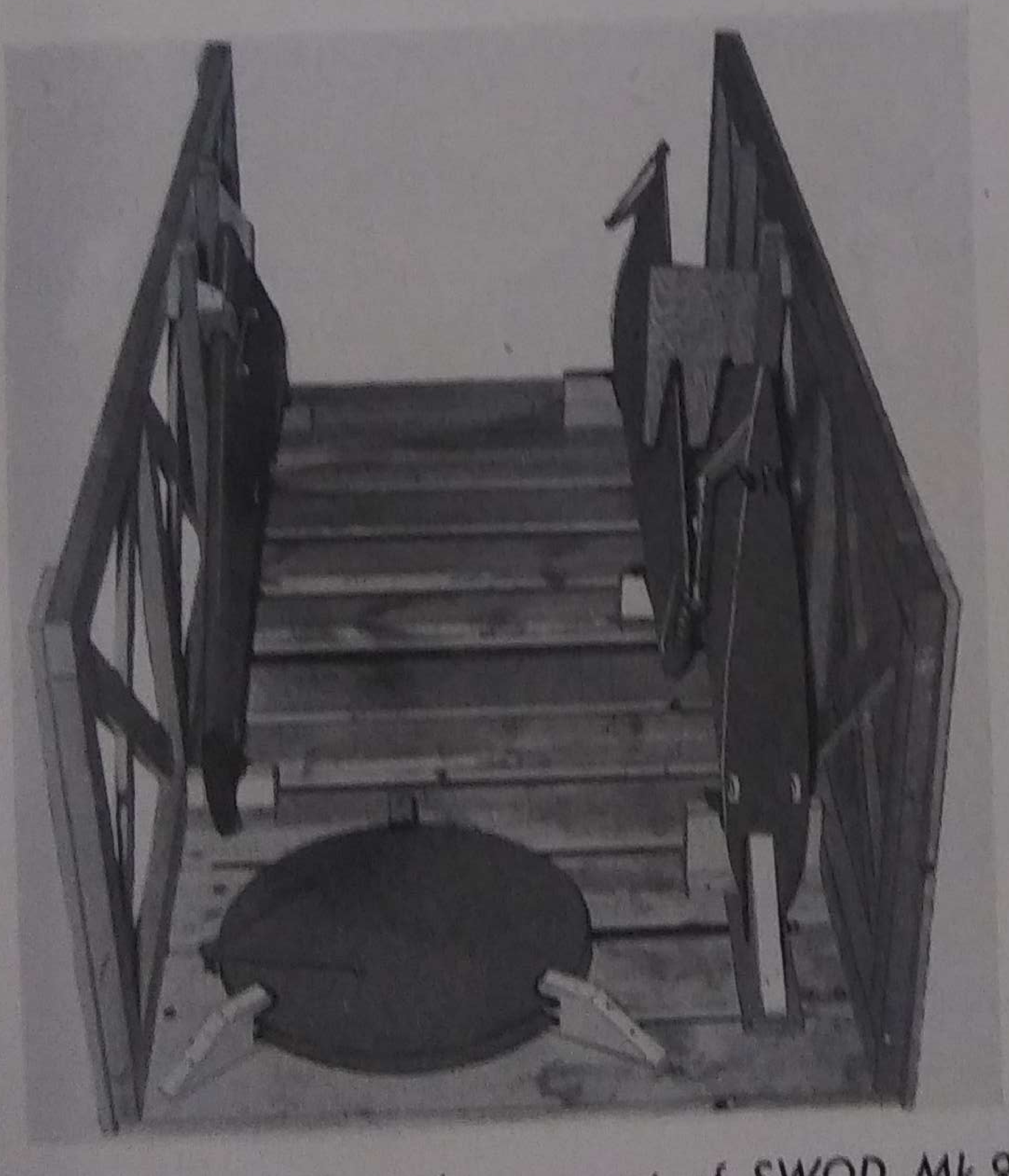

Figure 19—Packing Arrangement of SWOD Mk 9 Wings and Stabilizers.

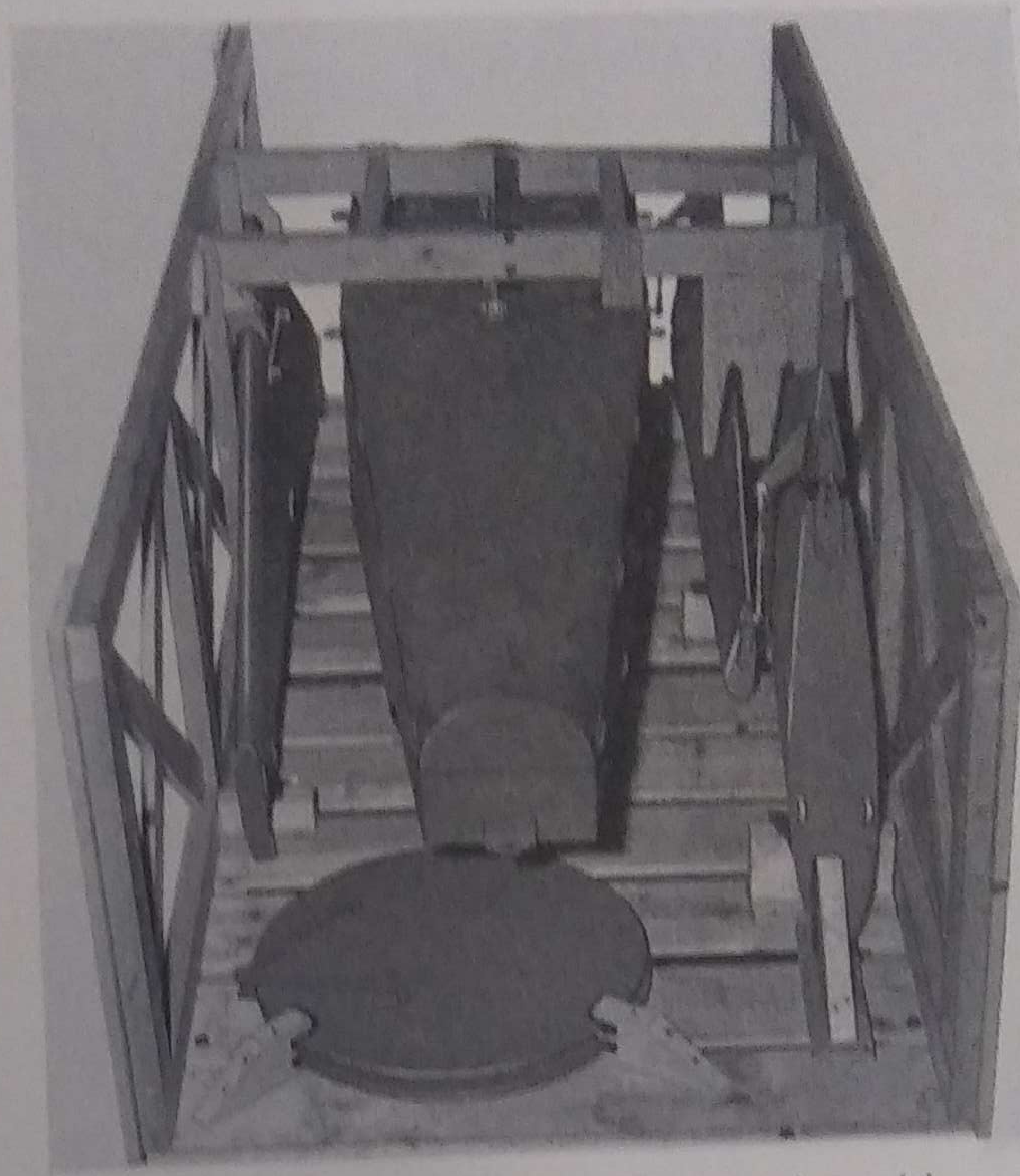

Figure 20—Complete Packing Assembly.

Butvar envelopes are placed around the fuselage and wing units prior to mounting in the crate. These envelopes completely seal and waterproof these three units. The padding provided for the clamps and bracing is cork, to withstand high moisture conditions. These envelopes should be left on the units for most satisfactory storage conditions. In Figures 19 and 20 the Butvar envelopes have been omitted for clarity.

UNPACKING: It is suggested that the following procedure be followed in unpacking the crate:

(1) Place the crate in a convenient location resting on the skids.

(2) Remove the steel bands from around the crate.

(3) Remove the top and ends of the packing crate. These are secured by screws. The unit will now appear as in Figure 20, except that the Butvar envelopes are omitted in the picture.

(4) Remove the bottom fairings of the fuselage in order that the unit may be rested on the lower longerons when removed.

(5) Lift the fuselage from the crate, carrying

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the center cross bracing with it, and place it on horses or other convenient rests. The supporting rack and top fairings are then removed (Figure 21).

(6) Remove the wings and stabilizer units when required. It is desirable to leave these units in the crate until required for service use unless wing and stabilizer racks are available for adequate support and protection. The Butvar envelopes afford additional protection against moisture and dirt, and should be left on until the units are needed.

MODIFICATIONS: Due to the fact that the destructor which was to be used for destroying the unit has been eliminated, and the fact that the tail elevator which is used to improve the flight of the missile has been added, certain modifications have been made on the SWOD (Air Stabilizer) Mk 13 Mod 0. These modifications are made as an improvement on the Air Stabilizer Mk 13 Mod 0 and also when converting from a Mod 0 to a Mod 1. However, there are additional modifications necessary to completely convert from a Mod 0 to a Mod 1. These are given in the Appendix B.

The modification procedures for the improvement of the Air Stabilizer Mk 13 Mod 0 are given below:

NOTE: Determination of the right side or left side is made by standing behind the air stabilizer and looking toward its nose.

(1) Preparation for modification:

(a) Uncrate SWOD (Air Stabilizer) Mk 13 Mod 0 from the master crate. Do not assemble.

(b) Remove all upper and lower cowlings.

(c) Mount the fuselage section on a suitable work fixture.

(d) Tighten all screws, nuts and bolts on the fuselage section. Do not overtighten.

> NOTE: Special note should be taken of the 24 bolts which secure the metal center section to the longerons, the 10 bolts securing the bulkhead mounting brackets, and the 6 bolts securing the brackets which hold the horizontal stabilizer. The heads of the 12 screws which secure the upper longerons to the metal frame are concealed beneath the plywood skin. When these bolts are tightened the thread end of the screw should be held with a hand

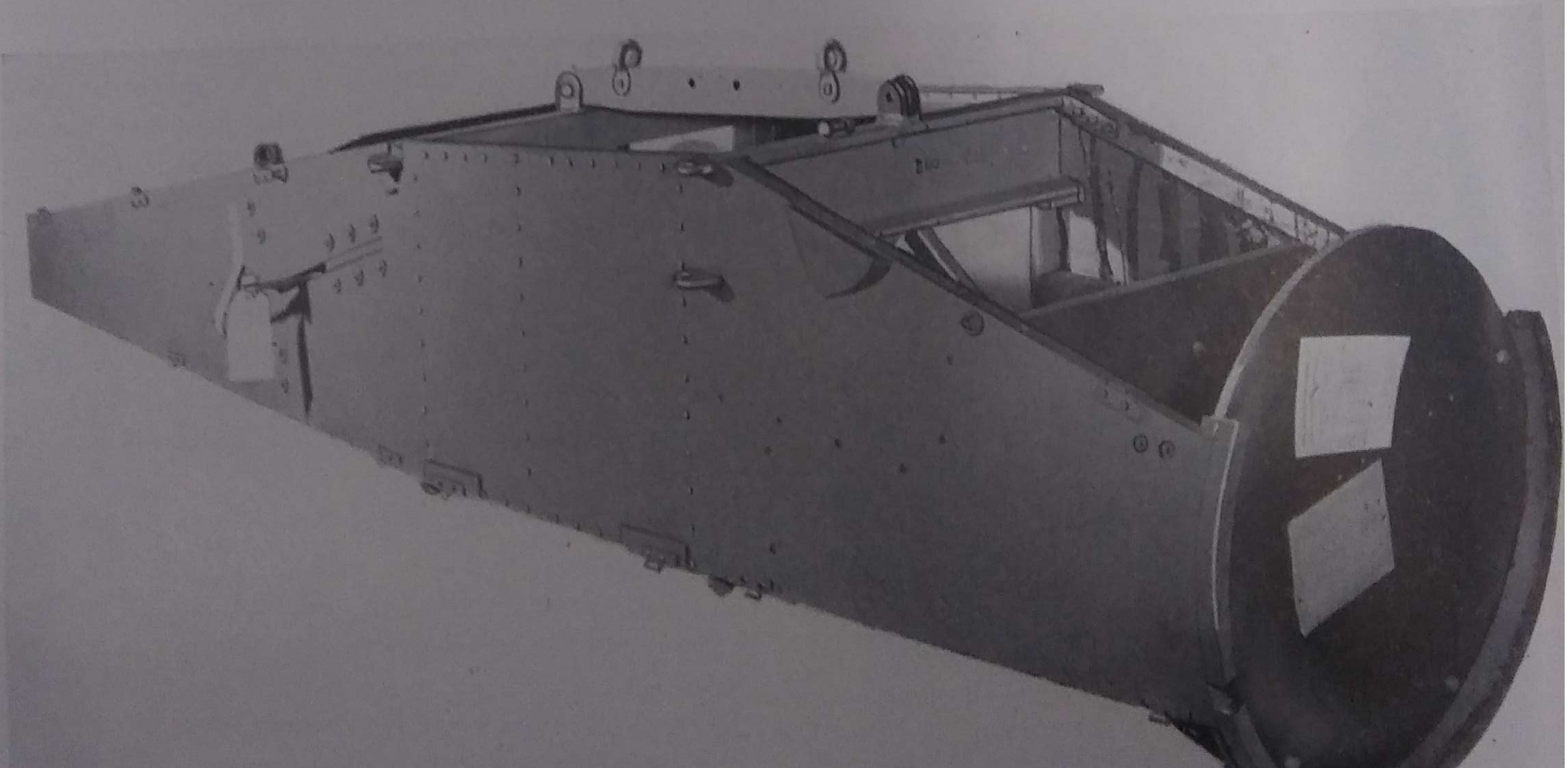

Figure 21—SWOD (Air Stabilizer) Mk 13 Mod 0 Fuselage.

vice if the screw turns while nut is being tightened.

(e) Remove the cable clamp mounted on the front of the inverter shelf which formerly held a prima cord cable. The demolition wiring harness included with the air stabilizer may be salvaged.

(f) If the air stabilizer has two arming wire guides on the top left front longeron, remove one guide. Also remove the arming wire guide on the top right front longeron.

(g) Check to see if the elevon horns on the wing sections need to be replaced. Replace with special elevon horns if serial number of air stabilizer appears in the list at end of Appendix B.

(h) Tighten all nuts, screws and bolts on the wing sections. Do not overtighten. **Note:** The four nuts securing the tail attachment fittings should be tightened as described in section (d) (p. 24) for the SWOD (Air Stabilizer) Mk 13 Mod 0.

(2) Modification of fuselage section:

(a) Close the hole on the left side of the fuselage with supplied patch plate A6914–1024–1.

(b) Cut the inverter shelf for additional clearance as shown in figure 136, using utility or cabinet saw.

(3) Modification of cowlings: Modify the lower cowlings by removing the inertia switch arming coupling from the right side of the lower front cowling. Replace the mounting screws in mounting holes with the nuts on the inside. Fill the large hole with supplied patch plate A6914–1024–1.

Modify bomb braces as follows: (**Note:** See special instruction under (h) below for fuselage bearing serial numbers less than 551 and refer to Figure 136.)

(a) Turn the fuselage upside down.

(b) Remove the bomb brace angles from the metal center section. Disassemble the bars from the angle sections.

(c) Drill a 9/32-inch hole in each angle section in line with and midway between the holes by which the angles were mounted to the fuselage.

(d) Remount the angles to the fuselage center section in such a manner that the angles are 1-inch forward from the former position. This is accomplished by bolting the second hole in the angle with the first hole on the center section and the rear hole of the angle with the third hole from the front on the center section. Before mounting zinc chromate the drilled holes for rust protection. **Note:** In cases where the nuts of the hinge mounting bolts interfere with mounting, grind off the angle corner to provide proper clearance. Zinc chromate all surfaces where plating has been abraised on angles or metal center sections.

(e) Using the mounted angles as templates, drill (use 9/32-inch drill) the forward and center holes of the angles through the fuselage metal center section. Zinc chromate the drilled holes. Install screws and bolts in holes drilled.

(f) Check to see if turnbuckles on bomb suspension straps are on the left side of the fuselage. (**Note:** The fuselage is upside down thereby reversing sides.) If they are not, unmount and then remount them so that the turnbuckles are on the left side. Also check to see if the clevis pin and bolt holding the front bomb strap is inserted from the bomb brace side.

(*g*) Mount corrugated bar on the right side angle. Correct positioning of the corrugated bar will be accomplished when the bomb is actually installed.

(*h*) Special instructions for bomb braces on fuselages bearing serial numbers less than 551 is given below. Obtain special bomb brace angles, bars and hardware from SWOD supply depot.

Remove bomb brace angles and bars completely. No holes are to be drilled.

Observe and accomplish foregoing section (f) if necessary.

Install the bomb brace angle without clinch nuts or corrugations on the left side of the fuselage using the same hardware which mounted the removed bomb braces.

Mount the bomb brace angle with clinch nuts and corrugations on the right side. Also mount the corrugated bar to the right angle.

(i) Mount 3064–F–5 clamp with the hardware provided as fuse holder. Locate as shown in Figure 138. The exact location is not important.

(j) Turn the fuselage over to its normal position.

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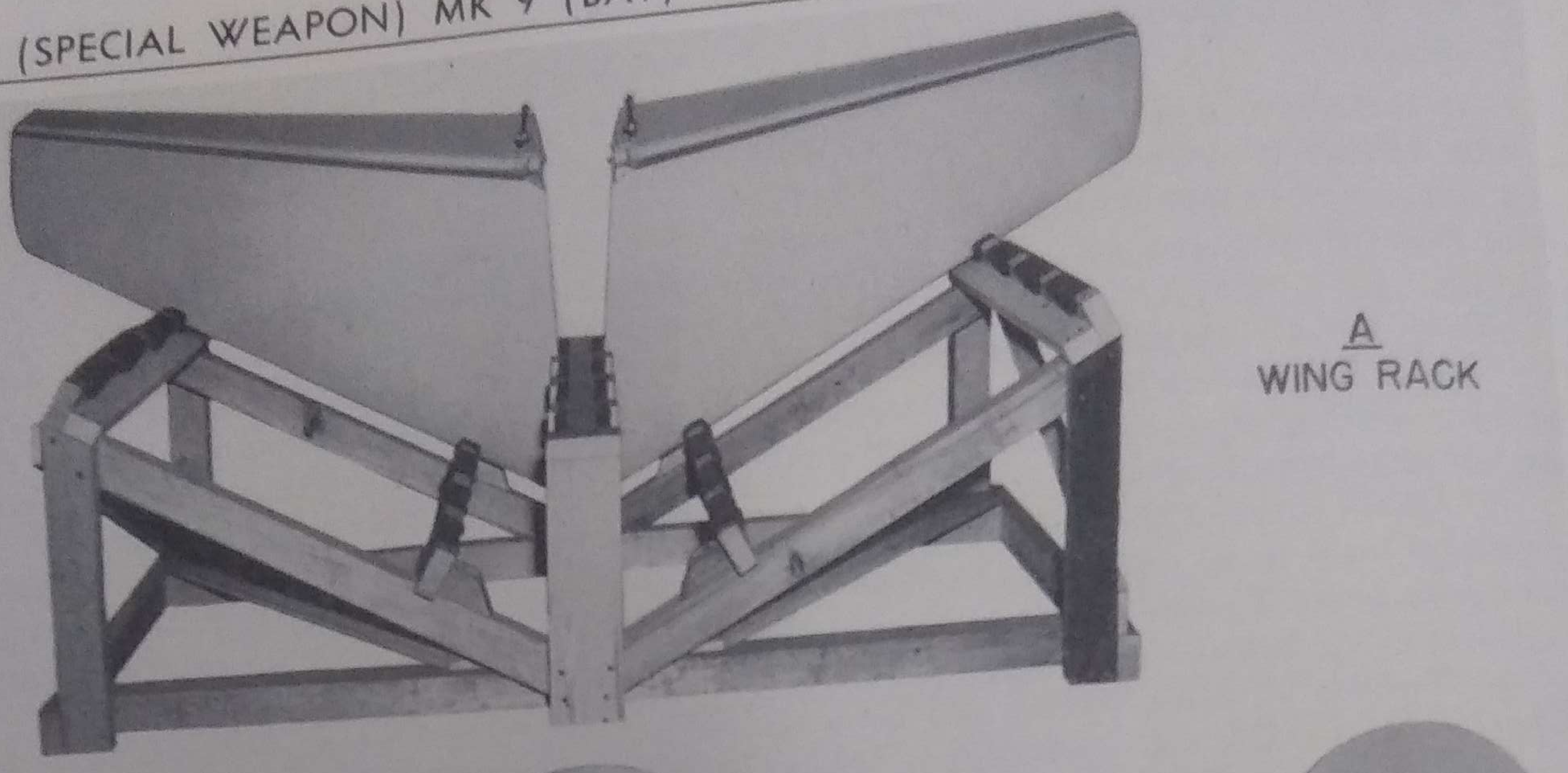
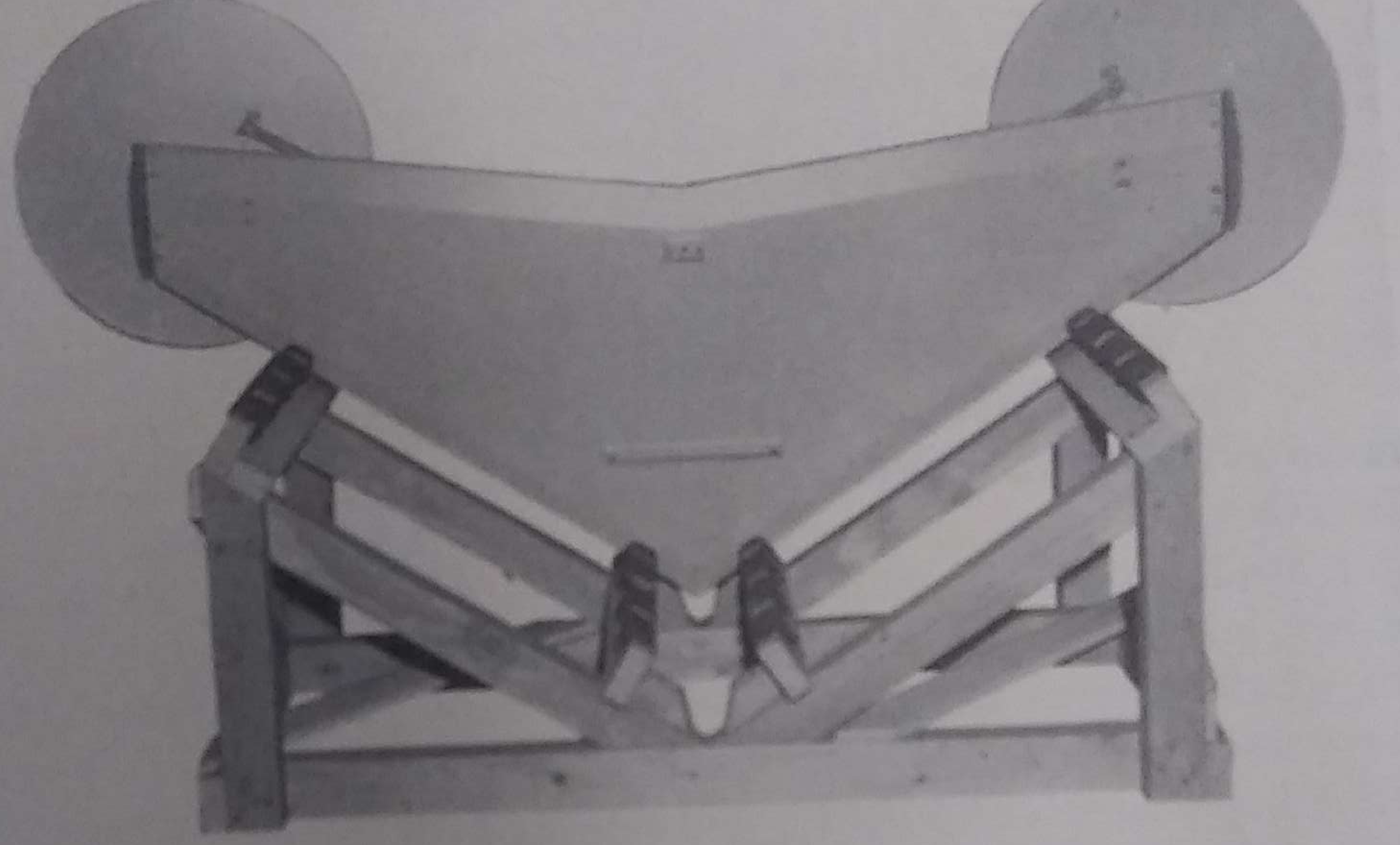
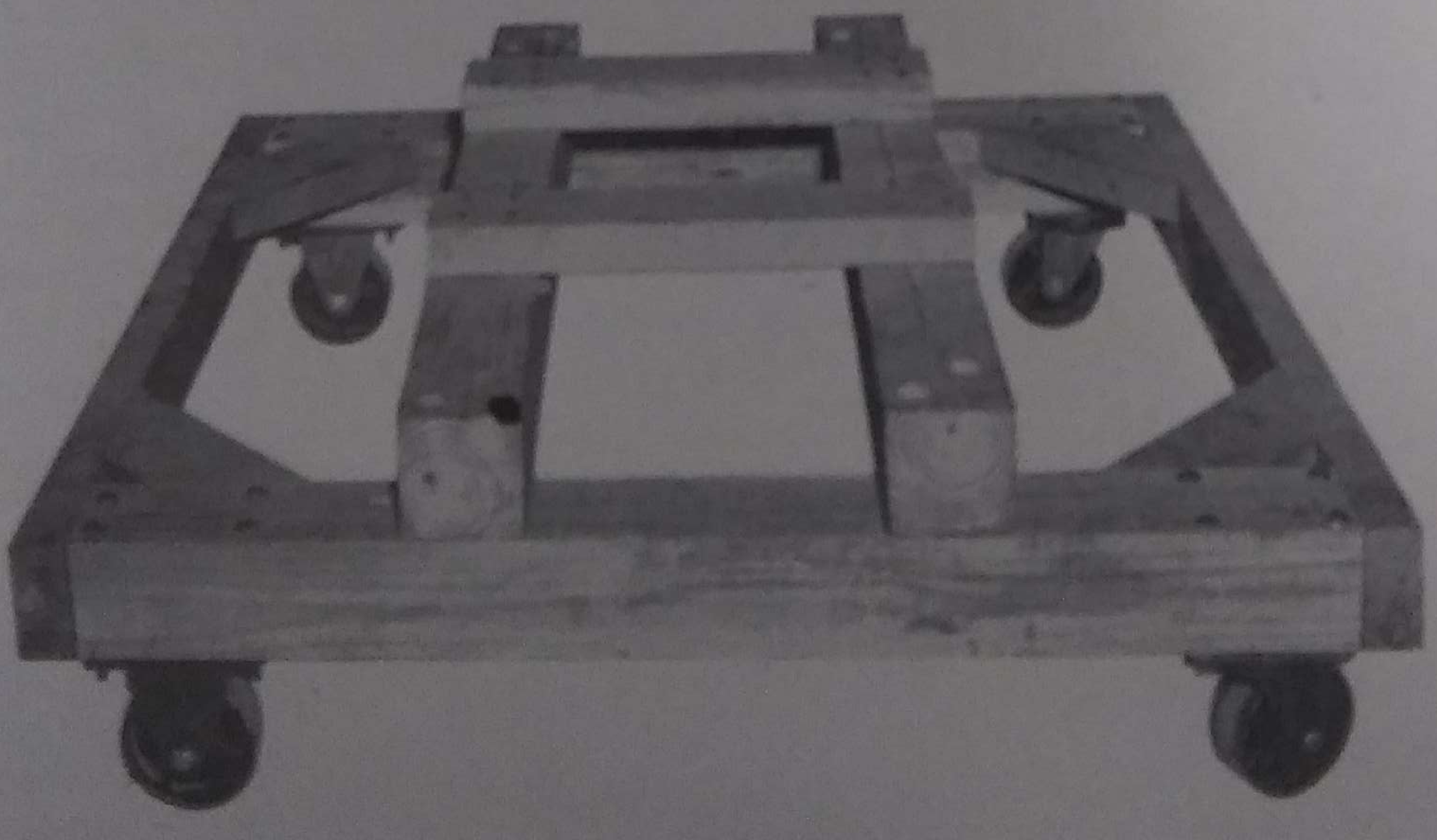


A
WING RACK



B
TAIL RACK



C
WOODEN SKID

Figures 22A, 22B, and 22C.

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Mod 0 or Mod 1 should be handled and transported or stored only by supporting it by the suspension bar or by resting it on the lower longerons or on the bomb when the bomb is in place with the center bottom fairing removed. The fuselage should be stored in a horizontal position. Lumber from the packing crates may be used for wing and tail racks, horses, skids, dollies, or other convenient items for handling and storage. See Figure 22-A, B, and C for examples of this type of equipment that can be constructed in the field.

The Venturi tubes are constructed by soldering many parts together and are designed to be used only as Venturi tubes. To prevent them from being damaged they should never be used as bulkhead handles or props and should be shielded from hard blows at all times.

f. Adjustments and Test Equipment

Certain adjustments and preflight settings are required for satisfactory flight. These adjustments and settings are made at the time of assembly and are sometimes checked for service use, particularly if the unit is not used for some time after assembly.

(1) ELEVON ADJUSTMENT: Since the elevons are rotated by the servo unit through the control rods, the proper limits of rotation are obtained by adjusting the length of these rods and by the settings of the limit switches in the servo unit (see Section 8, page 56). Angular displacement from neutral may be measured with a clinometer. After adjustment, the elevons should be run through their entire range of operation and the control rods checked to be sure that they do not bind in any position.

(a) *Elevon Limits.* The limits of upward and downward elevon rotation for flight control are determined by the permissible displacement consistent with safe flight. These limits of the elevons when used with SWOD (Servo) Mk 4 Mod 4 are:

Downward rotation from neutral (glide)	21.5°	±1.5°
Upward rotation from neutral (dive)	28.5°	±1.5°
Differential rotation each way from neutral (right-left)	13.5°	±1.5°

(b) *Elevon Neutral Jig.* The elevon neutral jig (Figure 23) is designed to slip over a main wing panel to align the elevon in its geometrically neutral position. The jig consists essentially of a rectangular frame with two movable cross members. The two horizontal members each support an adjustable gauging screw and the cross members each carry a notched plate to fit over the leading and trailing edges of the wing.

As the main wing panel has a symmetrical air foil, the distance from the horizontal members of the jig to the upper and lower wing surfaces is the same, when the elevon is in the neutral position. The adjustable gauging screws are preset to equal lengths. The elevons should be set in "neutral" with respect to the wing at wing station 17.875. This station is located 17.875 inches from the base of the wing or 29⅛ inches from the axis of the ship. When the jig is in place on the wing and the upper and lower gauging screws are in contact with the wing surfaces, the centers of the notches on the cross-members establish a chord line of the wing and the elevon is correspondingly in the geometrically neutral position.

The following procedure is recommended for setting the elevons in neutral:

The servo mechanism that controls the elevons must be set in the neutral position. This is accomplished by removing the knurled aligning key in the front of the servo unit and inserting it

Figure 23—Elevon Neutral Jig.

on the end of one of the two keyed shafts located behind the dust covers on the front face of the unit. Turn the key until the line on the end of the shaft directly below and perpendicular on the metal bottom cover is adjacent to the shaft. This is done only on the Mod 0 airframes.

Remove the bolt through the Fafnir bearing that holds the elevon tie rod to the link from the servo, then disconnect the rod from the lever at the bearing.

Place the jig across the wing surface with the two gauging screw heads on the trailing edge close to the elevons. See Figure 25–A.

Press the forward cross member against the leading edge of the wing until the jig is firm. The wing should fit snugly between the two gauging screws and the V cut in the cross member against the leading edge.

Push the after cross member against the trailing edge of the elevon and adjust the elevon to fit snugly in the V cut. This places the elevon in its neutral position.

Adjust the elevon tie rod to the proper length by screwing or unscrewing the Fafnir bearing at the servo lever end of the rod. Reconnect the rod and the lever and replace the bolt through the Fafnir bearing, making the bolt fast with a cotter key.

To check the elevon neutral setting, turn the elevon neutral jig over by revolving it 180° about its long axis. It should fit snugly between the gauging screws and the two cross members when they are slid into position. If the elevons do not check satisfactorily, either the preceding steps were not correctly carried out or the gauging screws were out of adjustment. After final adjustment paint the threads of the push rods with glyptol.

(c) *Elevon Neutral Gauge.* An elevon neutral gauge may be used to serve the same purpose as the jig described above. The gauge, which has the appearance of a T-square, is placed on the wing with the head along the trailing edge of the elevon and the shank lying flat on the elevon and pointing toward the leading edge of the wing. On the forward end of the shank there is an adjustable gauging screw. With the gauge in position on the wing surface this gauging screw is adjusted so that the point just touches the wing surface. The shank of the gauge must lie flat on the top surface of the elevon and should not be raised by the gauging screw, when it is adjusted. The gauge is then put on the under side of the wing at the same position along the elevon and the clearance of the gauging screw from the under wing surface noted. As the airfoil is symmetrical the elevon is in neutral when the gauging screw indicates the same distance from the gauge shank to the wing surface on both the upper and lower surfaces of the wing.

(2) DECALAGE—DESCRIPTION AND ADJUSTMENT. The decalage of the air stabilizer is defined as the angle at which the fore-and-aft axis (chord line) of the horizontal stabilizer is adjusted with respect to the fore-and-aft axis (chord line) of the main wing structure. In the SWOD (Air Stabilizer) Mk 13 Mod 0 or Mod 1 this is a negative angle of two degrees (leading edge of the horizontal stabilizer depressed). The instrument used to adjust this angle properly is called the decalage gauge, Figure 24.

The average decalage, which is the desired

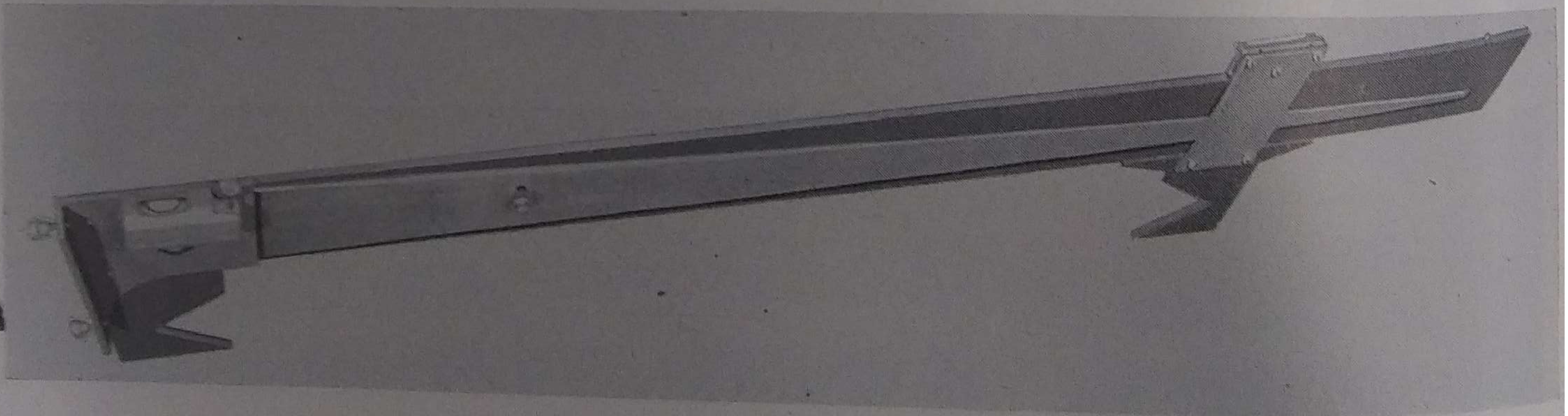

Figure 24—Decalage Gauge.

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reading, is defined as the average of the left and right decalage readings, obtained at established chord lines 17 inches from the axis of the ship. The average chord line is likewise defined as the average of the two chord lines 17 inches from the axis of the ship.

The average decalage for both the Mod 0 and Mod 1 shall be within 2° ± 8'.

To establish accurately the chord line of the wing and horizontal stabilizer, index lines are painted on each wing and on both the left and right sides of the horizontal stabilizer 17 inches from and parallel to the axis of the ship.

Decalage Gauge. This gauge (Figure 24) consists of a ¼-inch steel rail approximately 46⅜ inches long on the forward end of which is machined a V notch. Mounted on this rail at the opposite end is a movable slide into which is machined an equal and opposite V notch. The purpose of these V notches is for holding the gauge securely against the wing or tail surfaces while the decalage is being measured. Also mounted on the rail at the forward end is an adjustable pointer which is pivoted at a point above the forward V notch. On the forward end of this pointer is mounted an adjustable level glass lying in the same plane as the V notches. A scribed line necessary for accurate readings is scribed on the after end of the pointer. Two knurled knobs are mounted on the forward end of the pointer support. When the pointer is locked on 0° decalage or 5° spinner angle, the mounting surface containing the knurled knobs for securing the spinner angle gauge, forms an angle of 5° with respect to the center of the V notches on the lower side of the rail. These knobs are used for securing the spinner angle gauge to the decalage gauge in preparation for setting the "spinner angle." On the after end of the rail (at the end of pointer) spinner angle and decalage scales are engraved in degrees for direct reading. A pointer lock is provided in the form of a knurled screw in the rail which slides in a slotted hole in the pointer. If the gauge does not function properly or if out of alignment it should be sent to an instrument repair shop for realignment.

Procedure for Use of Decalage Gauge.

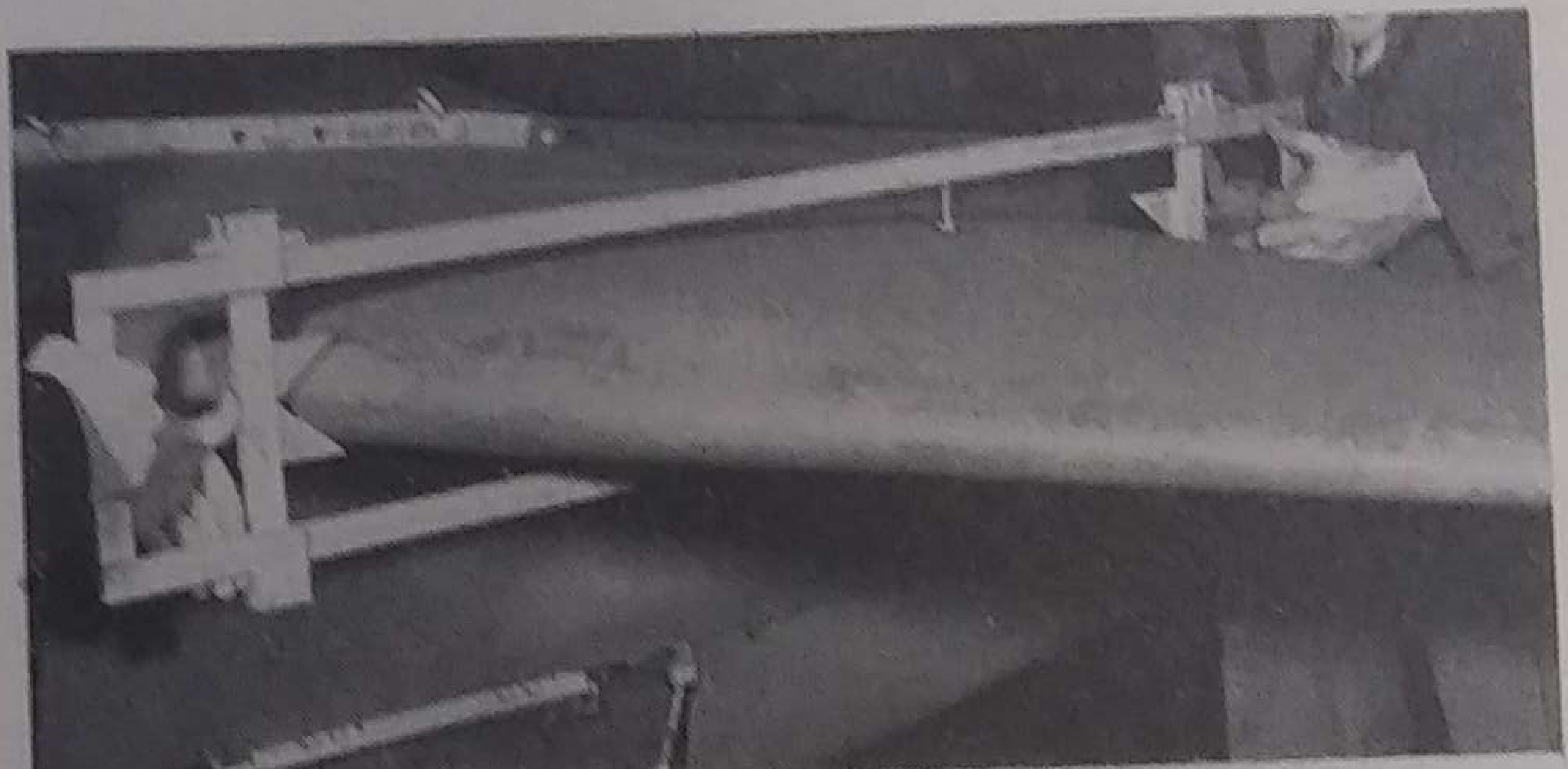
(a) Support air stabilizer rigidly and place elevons in neutral position as previously described.

(b) Release the pointer of decalage gauge by backing off the knurled locking screw and relock with the scribed line on the pointer at zero degrees on the scale.

(c) Hold the gauge firmly on the left wing with the fixed V notch on the indicating line at the leading edge, and the sliding V notch over the indicating line at the trailing edge of the elevon. During the measurements the gauge must be held in a vertical position with the level bubble on top.

(d) Adjust the level glass by turning the knurled screw on the level glass mounting until the level glass is balanced.

(e) Transfer the gauge to the indicated position on the left side of the tail (horizontal stabilizer), release the pointer and move pointer down until the level glass indicates a level position. The decalage for that side of the air frame may be read directly from the scale (Figure 25–B).



A.-ELEVON NEUTRAL JIG ON WING

B.-DECALAGE GAUGE ON TAIL

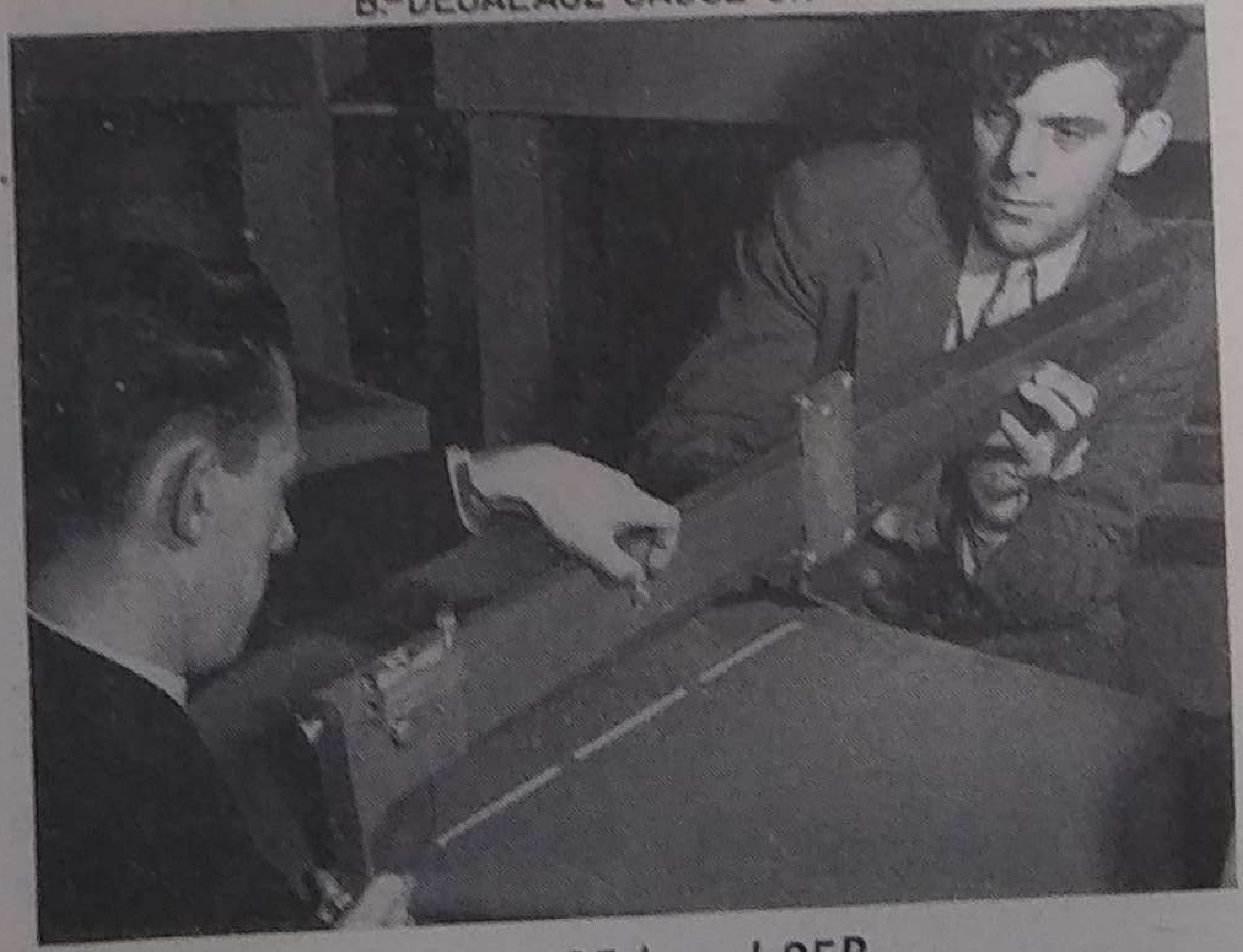


Figure 25A and 25B.

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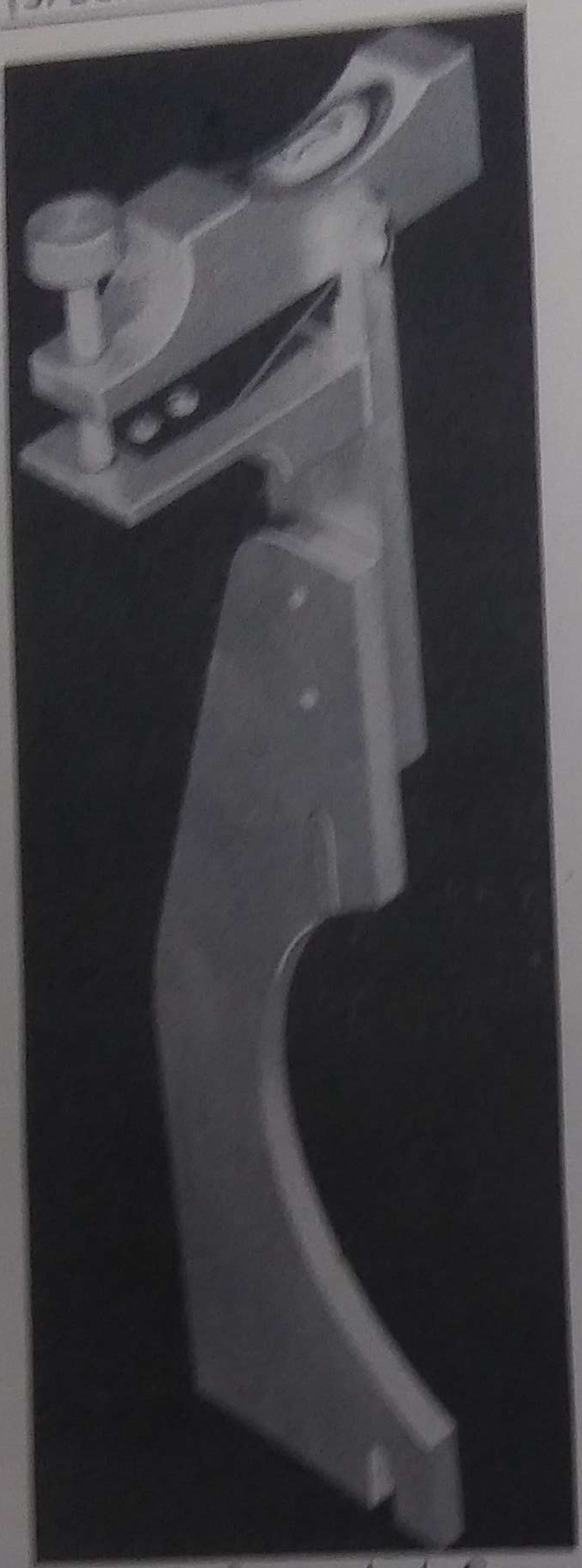


Figure 26—Spinner Angle Gauge.

(1) Repeat for the right side of the air frame. Add the readings for the two sides and divide by two. Example:

Left decalage (wing to stabilizer)	2°15′
Right decalage (wing to stabilizer)	1°52′
	4°07′
Average decalage $\frac{4°07'}{2}$	2°03′+

(2) SPINNER ANGLE ADJUSTMENT. The spinner angle gauge shown in Figure 26 is designed primarily to facilitate the proper adjustment of the "spinner angle," which is the pointing angle of the antenna with respect to a definite reference line perpendicular to the bulkhead on which SWOD (Radar) Mk 2 Mod 1 or Mod 2 is mounted. The rigid coaxial line of the antenna should point downward (forward and depressed) a given angle depending upon the construction and characteristics of the air stabilizer and varies slightly for each equipment as mounted. These values for the SWOD Mk 9 Mods 0 and 1 are given in the adjustment procedure below.

Description of Spinner Angle gauge. This gauge consists of an adjustable glass level mounted at right angles to a form piece of ½-inch aluminum sheet stock into which has been machined a semicircular guide. This guide is machined so that it will fit snugly against the driving gear of the spinner. Also on the form piece are machined two notches for securing the spinner angle gauge to the decalage gauge in preparation for adjustment of the "spinner angle."

Procedure for Use of Spinner Angle Gauge:

(a) With pointer on decalage gauge locked at 0°, set decalage gauge on left wing in same manner as for decalage setting.

(b) Adjust level glass to a balanced position.

(c) Remove gauge from left wing and place on right wing. Release pointer and move until level glass indicates a level position. The resultant difference from 0° is known as the angular divergence of the wing. When divided by two, the result will be the average divergence. Note average divergence in plus or minus figures.

(d) With decalage gauge remaining on right wing, attach spinner angle gauge attachment on front of decalage gauge by means of knurled screws. See Figure 27. Set pointer to required spinner angle setting which is three times the average decalage minus the average divergence of the wing for the SWOD Mk 9 Mod 1 (BAT-1). The required spinner angle setting for the Mod 0 (BAT-0) with the production type tail elevator is 1.75 times the average decalage. (The values for setting the spinner angles for the Mod 0 (BAT-0) and Mod 1 (BAT-1) are subject to change). The above calculation for spinner angle settings is made algebraically. Adjust the level on spinner gauge to a balanced position. Example:

WING DIVERGENCE

Left wing 0° Right wing +16′

$$\text{Average divergence } +\frac{16'}{2} = 8'$$

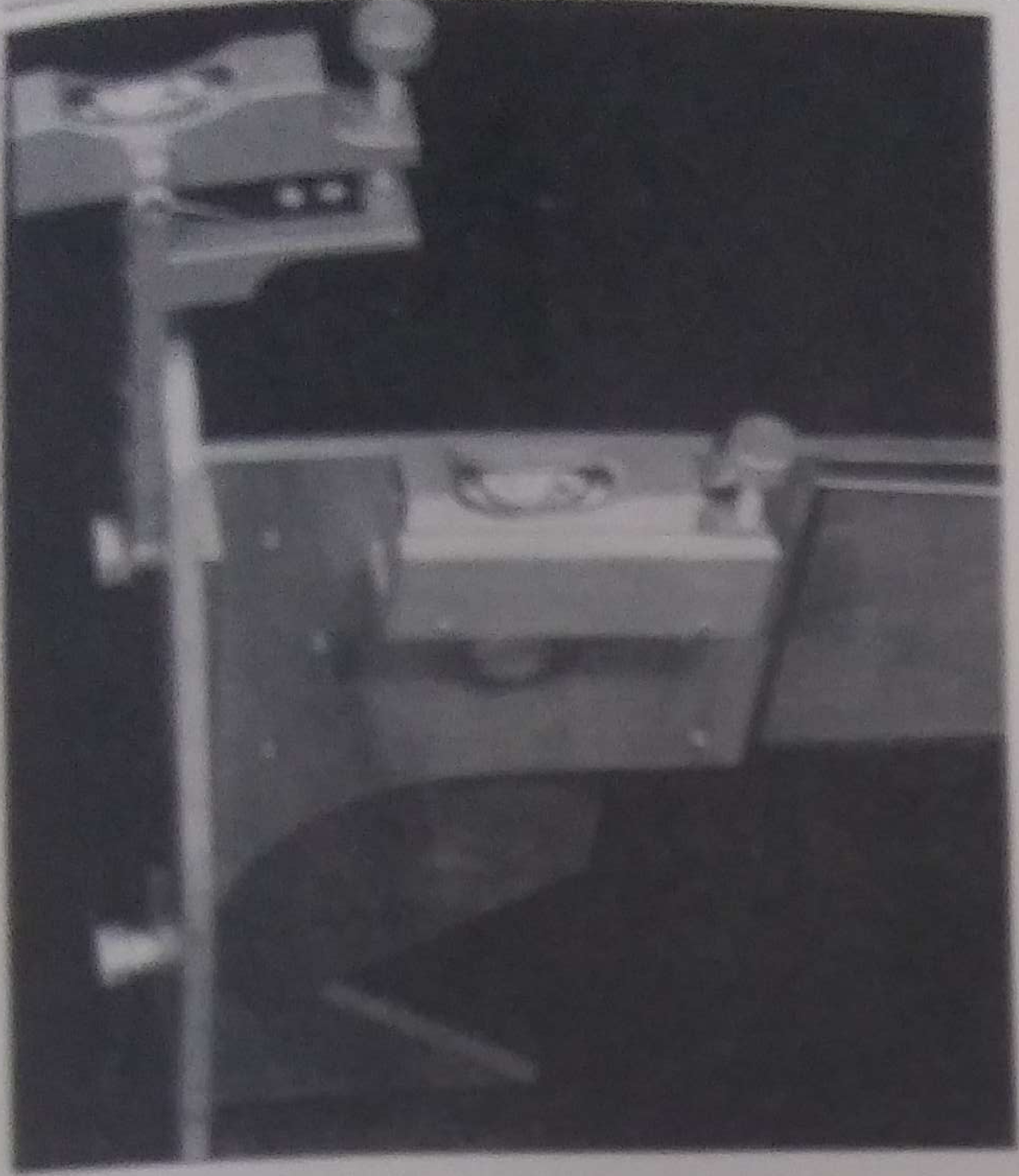


Figure 27—Spinner Angle Gauge Mounted on Decalage Gauge.

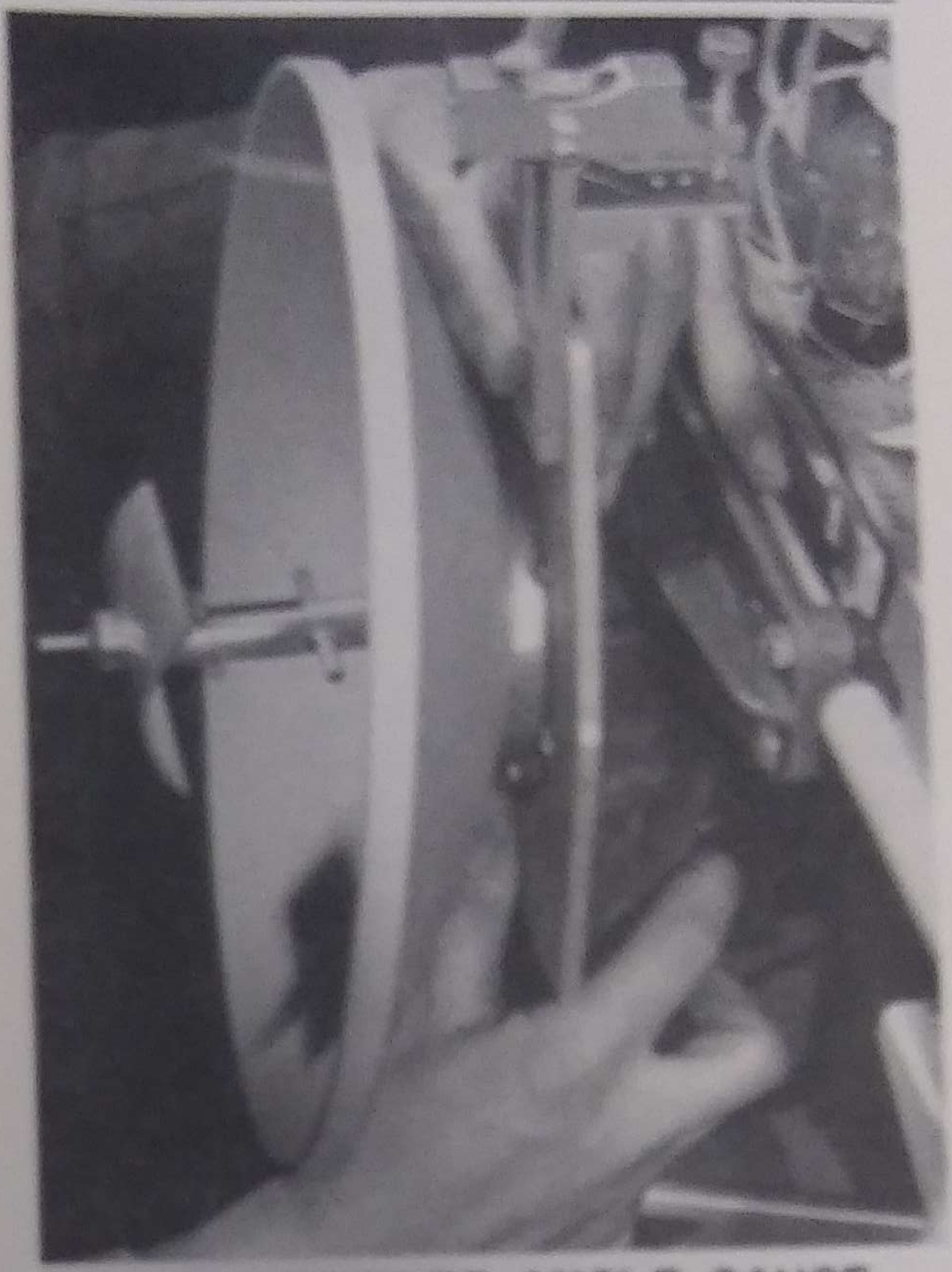
3×2°3′=6°9′−(+8′)=6°1′ (referred to right wing)=spinner angle setting.

(e) Remove spinner gauge attachment from decalage gauge and hold firmly against the driving gear on the spinner. See Figure 28–A. Make sure gauge is flush against surface and that there are not obstructions such as screws or burrs. With gauge held in position, have assistant adjust spinner until level glass returns to balanced position. The spinner adjustment is made by loosening the upper spinner frame clamp and then moving the lock nuts along the swivel bolt at the bottom of the spinner frame (Figure 28–B). Turn all bolts to proper tightness and safety with wire.

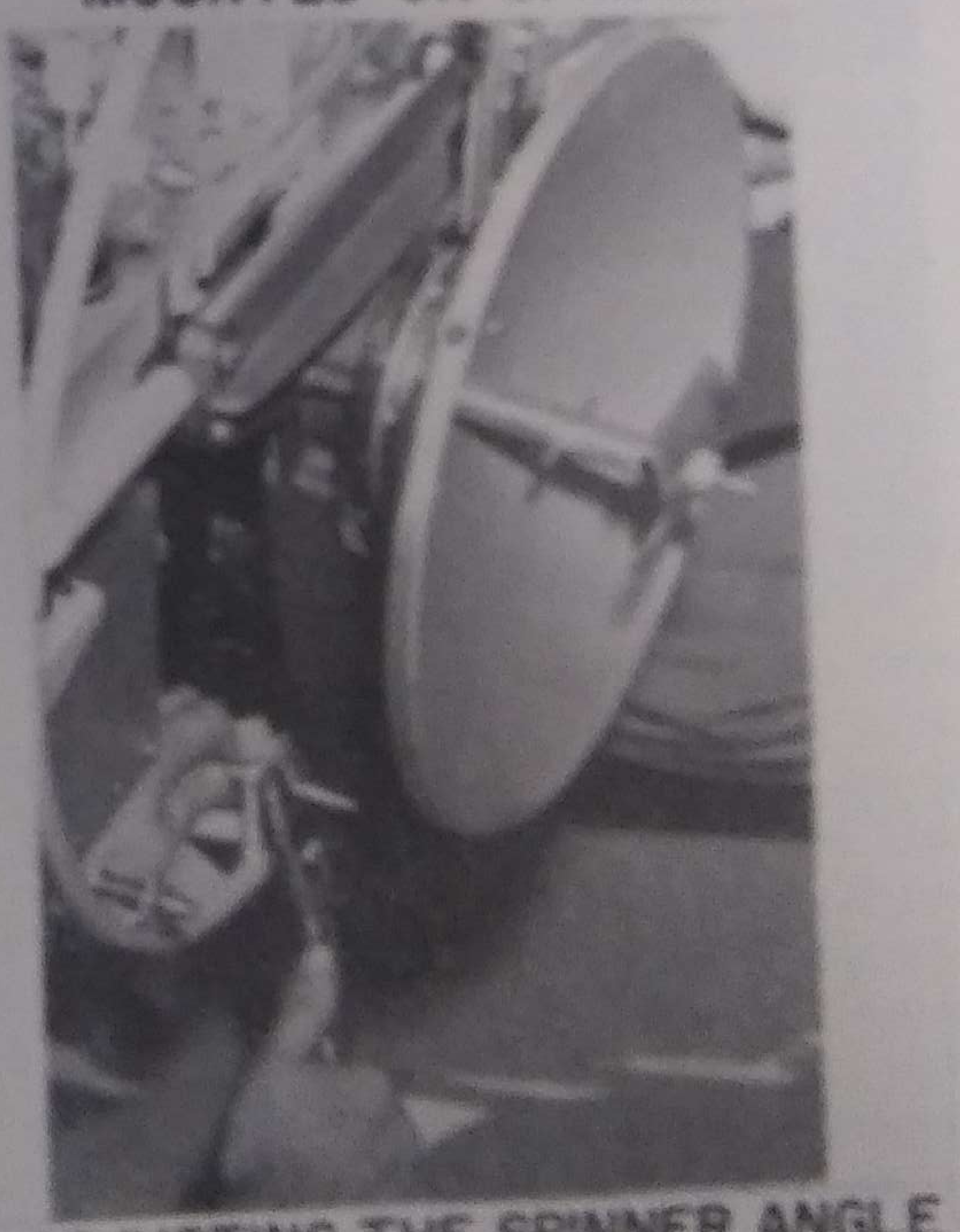
> Note: Occasional check of the alignment frame angle and the pointer angle at the front of the decalage gauge should be made. Make check of alignment with pointer set at 0°.

(4) Balance: The arrangement of the component units within the air stabilizer is planned so

Figure 28A and 28B.→



A.- SPINNER ANGLE GAUGE MOUNTED ON SPINNER



B-ADJUSTING THE SPINNER ANGLE

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that the center of gravity is properly placed for stable flight. The bomb, due to its concentrated weight, affects the position of the center of gravity greatly and must therefore be correctly mounted in the fuselage to place the center of gravity of the complete air stabilizer at the correct point.

The bomb is carried well forward in the fuselage, so that the front of the nose fuze is close to the main removable bulkhead.

There are three types of bomb braces. These are:

(a) The tap plate type which is used on air stabilizers numbered from 105 to 550 inclusive.

(b) The serrated type which is used on air stabilizers numbered 550 and up is shifted forward one inch so that the bomb will be located one inch forward.

(c) The modified serrated type is used only to replace the tap plate type and when used in place of the tap plate type automatically locates the bomb one inch forward of the original position.

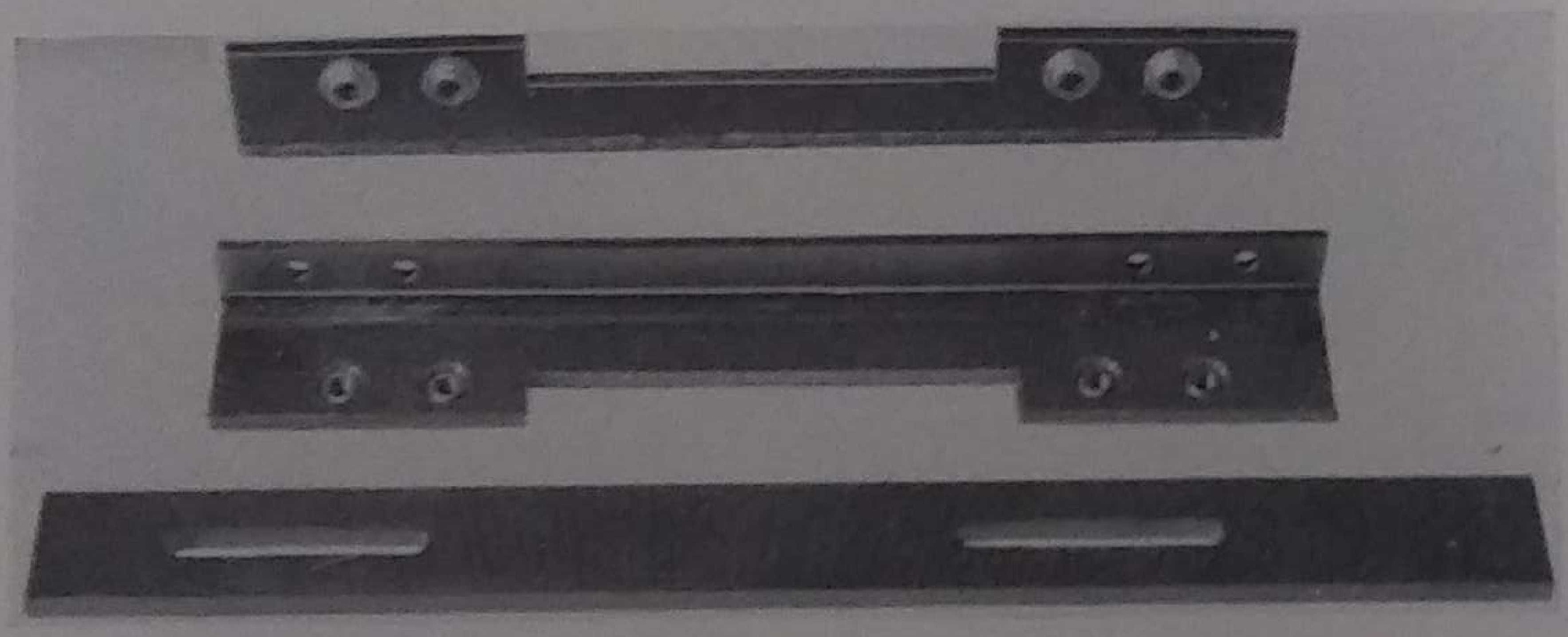

Figure 29—Serrated Bomb Brace.

The bomb brace, shown in Figure 29, is the serrated type used on air stabilizers with serial numbers over 550. A bomb brace similar to that in Figure 29 is to be used to replace the tap plate type bomb brace. With this type of brace, the single lug on the bomb fits securely in the slot of a fixed brace, Figure 30, which is attached to the steel center section of the air stabilizer at such a point that the bomb, when installed, will be correctly positioned. The two lugs on the other side of the bomb are utilized for fore and after bracing, shown in Figure 31. A bar which is adjustable in position fits between the lugs and is bolted to the piece attached to the air stabilizer. The contact surfaces between the bar and the right angle brace are corrugated to hold the bar in the proper position. Elastic stop nuts are

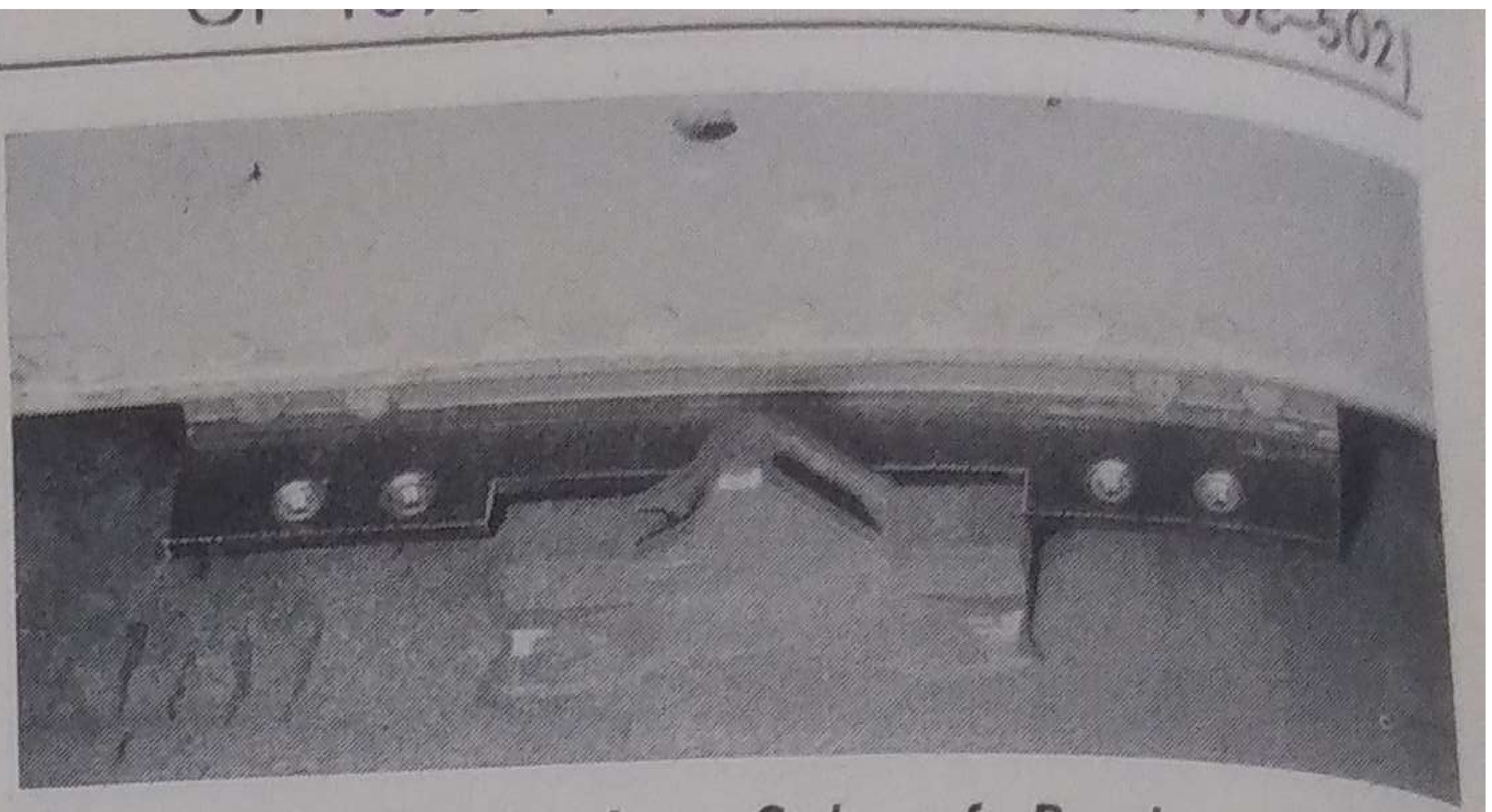

Figure 30—Single Lug Side of Bomb with Bomb Brace.

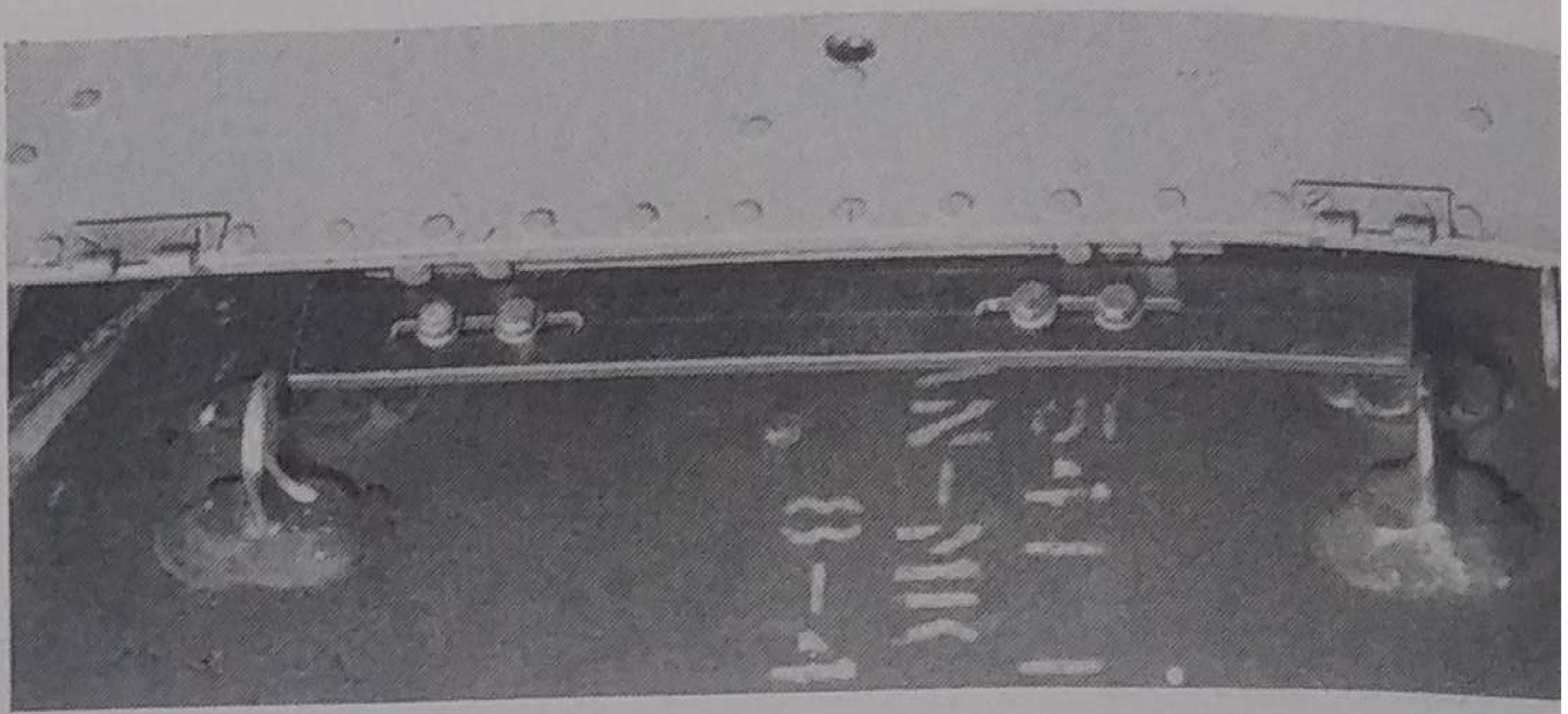

Figure 31—Two Lug Side of Bomb With Bomb Brac

pressed into drilled holes in the right angle mer
ber so that the bar-attaching bolts may be put
place easily.

The bomb lugs are not always located exac
at the same distance along the horizontal axis
the bomb, thereby causing a center of grav
shift of the bomb with respect to the hoisting l
To obtain balance, weights may be placed in
fuselage in the compartment abaft the batte
or mounted on the vertical front of the shelf wh
supports the inverter.

A single point suspension method for quic
and accurately checking the balance of an
stabilizer is recommended. To accomplish
check, all suspension bars are provided with
inch drilled hole. This hole which is *not*
hoisting hole is located just over the cente
gravity of the air stabilizer, when the ba
mounted. When the air stabilizer is suspen
by a pin through this hole, the fore and a
balance may be checked by means of a bu
gauge (Figure 32). The tolerance applicab
that the air stabilizer should be within plu
minus 5 pounds of balancing as measured at
tail. This may be read from the bubble ga
on the basis that if the bubble is between
outer tolerance marks, the balance is within t

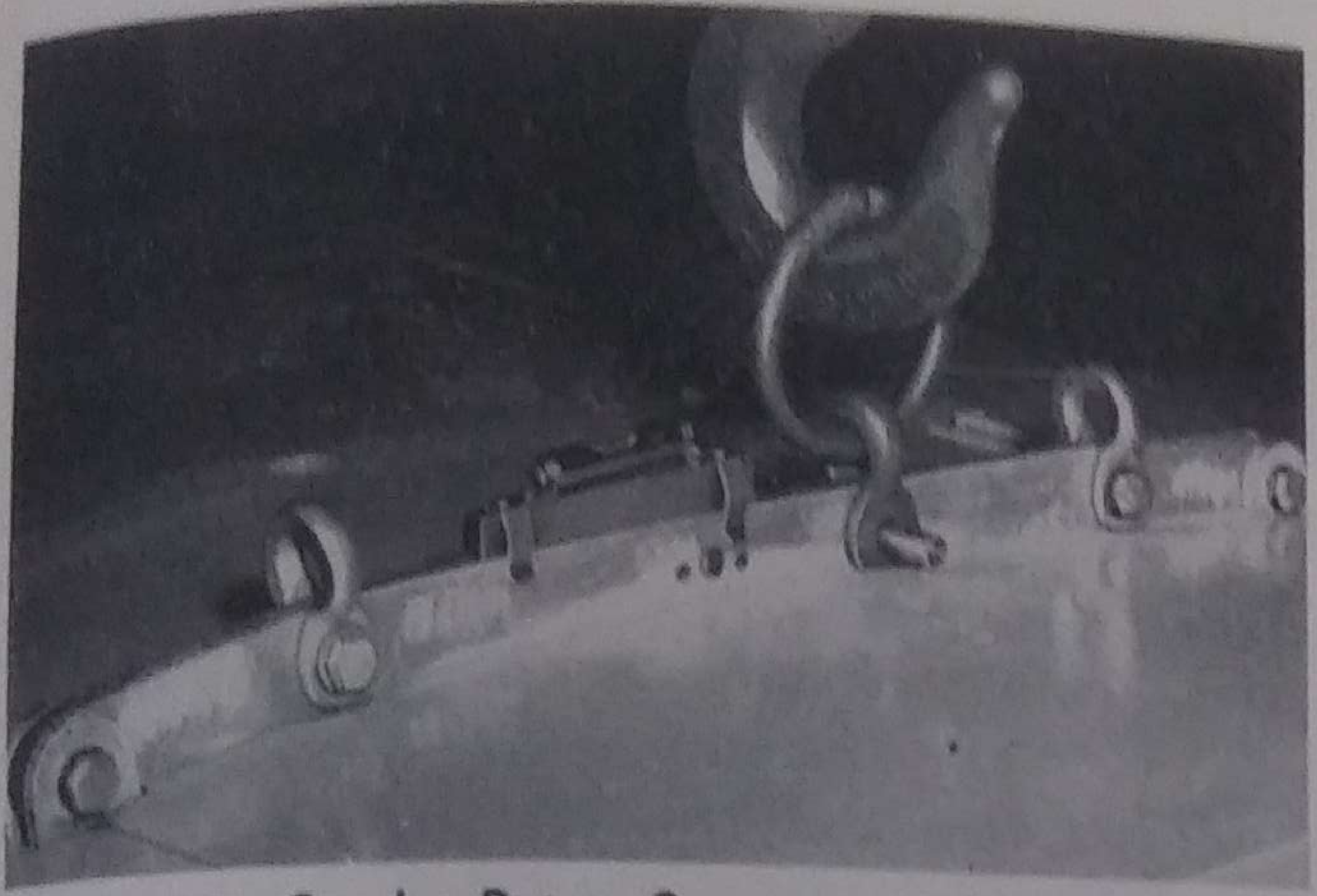

Figure 32—Single Point Suspension for Balancing.

ance. It will be noted that the bubble gauge is mounted at an angle of 4° on its clip to compensate for the normal slope of the suspension bar when the air stabilizer is level.

Since the balance in roll is not critical, the normal distribution of equipment within the fuselage is such that satisfactory roll balance results.

g. Care and Maintenance

The plywood construction of SWOD (Air Stabilizer) Mk 13 requires reasonable care in handling and storage. Care should be exercised in handling the component sections during assembly to make sure that they are not dropped or rested on unsupported sections of the plywood. The framework of the packing case or a suitable wing rack, tail rack, or shelves should be utilized wherever possible, to provide a satisfactory rest for the component sections, supporting them in the manner in which they are packed or resting them on the stronger edges of the sections. Reasonably dry storage space should be utilized to prevent warping. Skinned spots should be touched up with a suitable paint to reduce moisture hazards. See paint specifications under d, Construction and Finish, page 18.

Realignment of the fixed structures of the air stabilizer cannot be accomplished satisfactorily in the field with the equipment usually available. Should noticeable warping occur on any of the component sections, a new section should be used.

2. SWOD (AIR STABILIZER) MK 13 MOD 1

The SWOD (Air Stabilizer) Mk 13 Mod 1 (Figure 2) is used with the SWOD (Special Weapon) Mk 9 Mod 1 and is fundamentally the same as the Mod 0 air stabilizer. However, there are certain modifications necessary for converting the Mod 0 air stabilizer to a Mod 1. These modification instructions are given in the Appendix B.

3. SWOD (RADAR) MK 2 MOD 1 (RADAR SET AN/DPN-1)

The purpose of SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) is to provide directional information for control of the missile during its flight. Change of course information from the radar is applied to the control gyros of the air stabilizer whenever it deviates from a pursuit course.

The radar assembly is composed of a transmitter-receiver, antenna assembly (containing an offset, parabolic reflector), a target-selector and gating circuit, a directional control circuit, and a memory circuit. It is also provided with a junction box which contains a breakaway plug for connecting the radar to the aircraft control equipment. Figure 33 shows the SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) with the inverter and power supply.

A detailed description of the operation, maintenance, checkout, and circuit theory of SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) is given in OP 688 (CO-NAVAER 16-30DPN1-500).

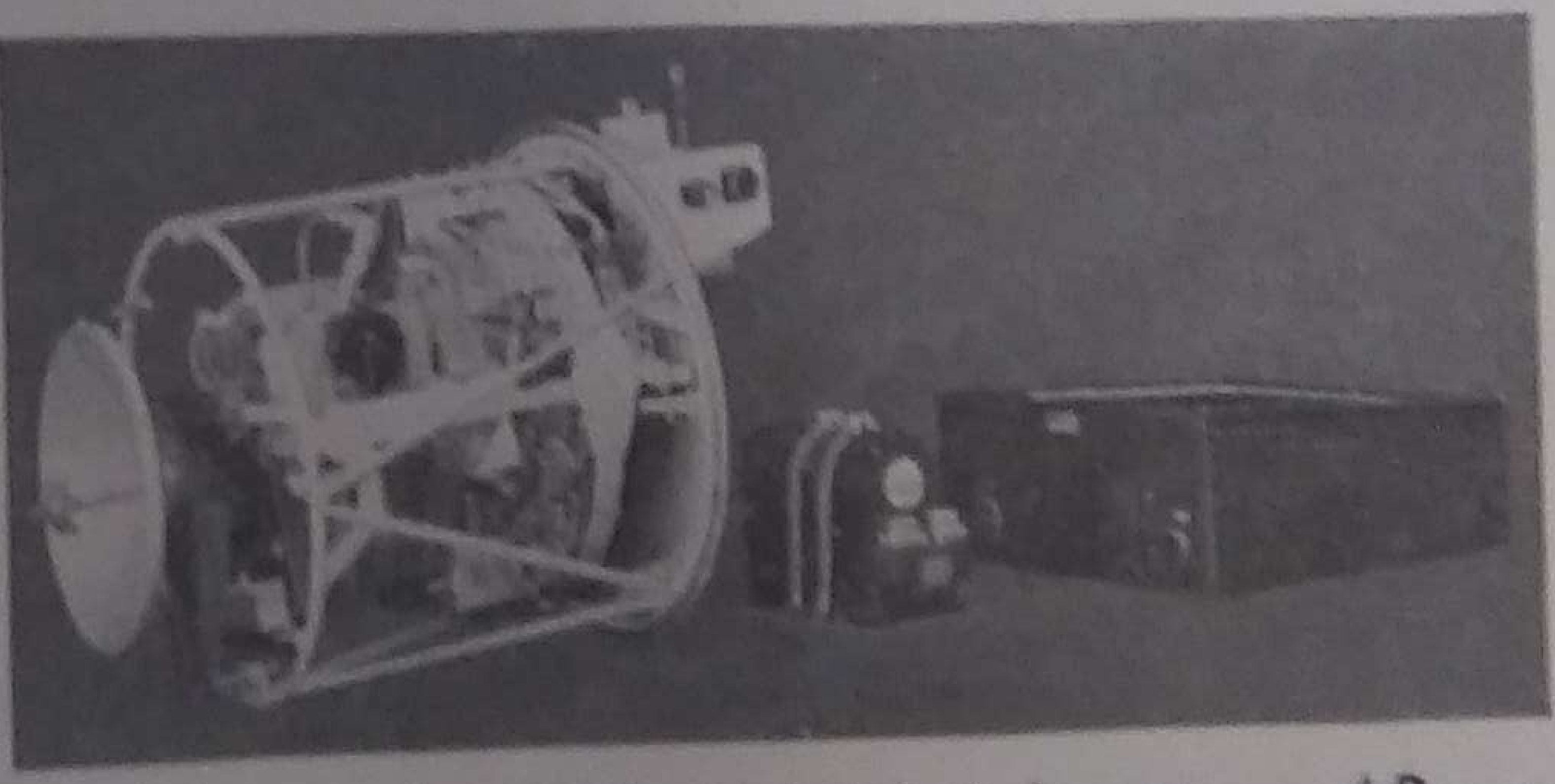

Figure 33—SWOD (Radar) Mk 2, Inverter and Power Supply Mk 16.

4. SWOD (RADAR) MK 2 MOD 2 (RADAR SET AN/DPN-2)

The purpose, general operation, and circuit theory of the SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2) is essentially the same as that of the Mod 1 (AN/DPN-1) radar. To convert the Mod 1 (AN/DPN-1) radar to a Mod 2

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(AN/DPN-2) for use with SWOD (Special Weapon) Mark 9 Mod 1 several modifications are necessary. Instructions for making these modifications are given in the Appendix of OP 688 (CO-NAVAER 16-30 DPN1-500), SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1).

5. THE POWER UNIT

a. Components.

The power unit which furnishes all the power for the operation of the radar equipment is composed of SWOD (Power Supply) Mk 16 Mod 1 or Mod 2 (Power Supply PP-284/DPN-1 or 285/DPN-2), and inverter and two 14-volt batteries. A third 14-volt battery is used for furnishing power to the servo mechanism. The Power Supply Mk 16 (PP-284/DPN-1) and the inverter are shown in Figure 33.

b. Inverter

A rotary inverter, which is energized from the plane's battery before the release of the missile and from two 14-volt batteries within the SWOD Mk 9 after its release, furnishes 800 CPS power at approximately 115 volts. The output of the inverter is fed to SWOD (Power Supply) Mk 16 (Power Supply PP-284 or 285), the high voltage rectifier located in the transmitter section of the radar unit, and to various heater and filament circuits. It is mounted in a housing between the bulkhead which supports the radar equipment and the SWOD (Power Supply) Mk 16 (Power Supply PP-284 or 285).

c. SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP-284/DPN-1)

The SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP-284/DPN-1) consists of a regulated rectifier, control relays and incidental wiring. The regulated rectifier is a unit containing three separate power supplies which furnish +285 volts, −200 volts, and −800 volts to the radar equipment.

The relays are operated by switches on the monitor located in the aircraft and enable the operator to transfer the inverter load from the plane battery to the SWOD Mk 9 battery.

Detailed descriptions of SWOD (Power Supply) Mk 16 (Power Supply PP-284 or 285) and the inverter may be found in OP 688.

d. SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP-285/DPN-2)

This power supply is essentially the same as the one in c, col. 1. However, certain modifications have been incorporated so that it may be used with SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2). These modifications may be found in OP 688 (CO-NAVAER 16-30 DPN1-500).

e. Primary Power

GENERAL: The SWOD (Radar) Mk 2 (Radar Set AN/DPN-1 or 2) is designed to operate from a direct-current source having a potential between 25 and 29 volts. When the missile is attached to the plane during search this source is obtained from the plane power; after the missile has been released, two 14-volt batteries located in the rear of the air stabilizer furnish the power. The total current drain at 26.5 volts is approximately 34 amperes.

BATTERIES: The Exide Storage Battery Type 7-TAS-9E is a 7-cell 14-volt storage battery of the standard lead-acid type. The capacity of the battery is approximately 34 ampere-hours. Each cell has nine plates with wood separators and is equipped with a nonspill vent plug. This battery is comparable in every way to the familiar automobile storage battery, although in certain applications special handling may be required to insure satisfactory performance.

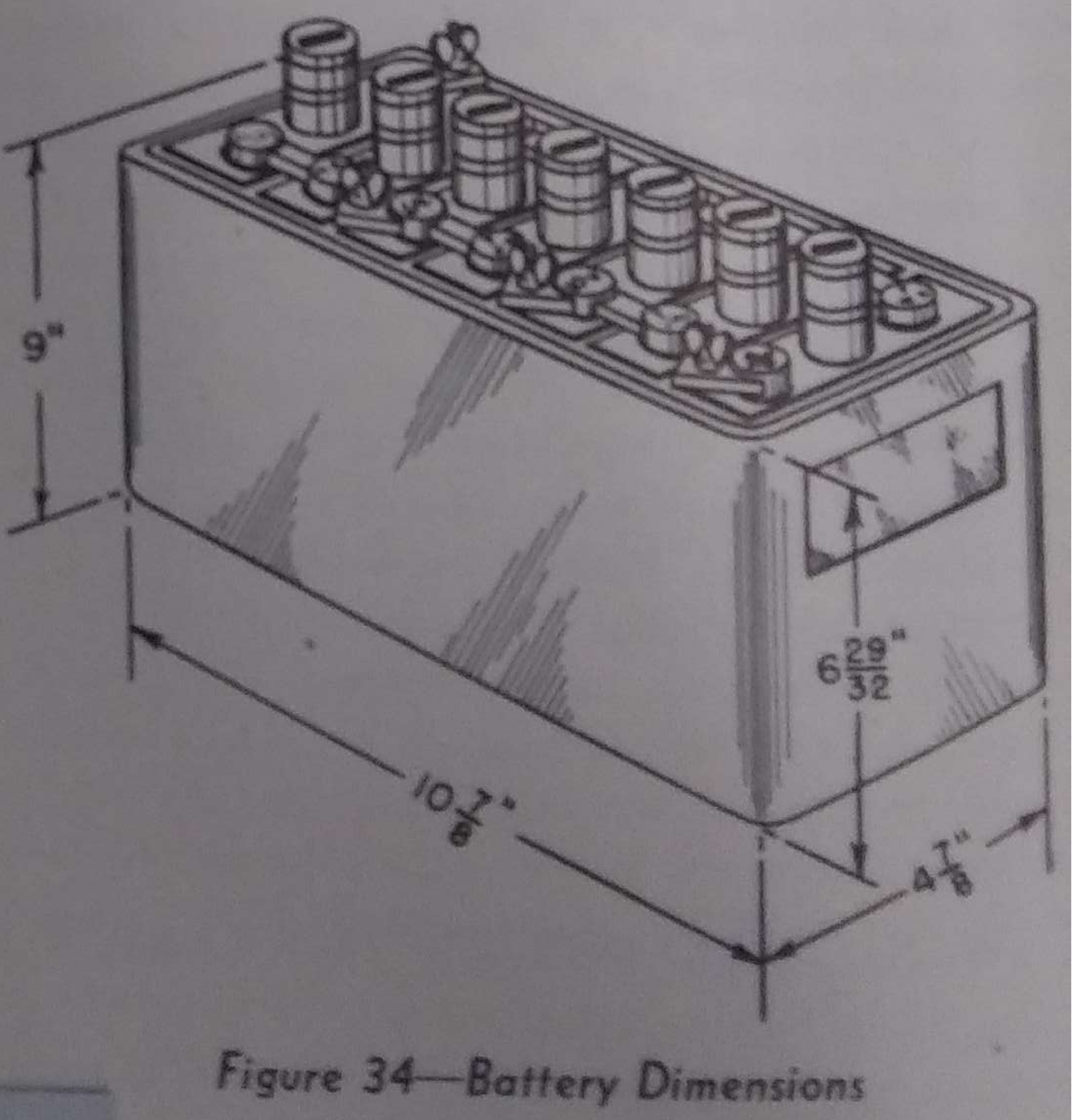

Figure 34—Battery Dimensions

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The overall dimensions are shown in Figure 34. Additional output terminals are placed at +6 volts and +10 volts in some batteries for flexibility in application with various equipments.

The battery is shipped dry charged. The electrolyte, dilute sulphuric acid of 1.275 specific gravity, is shipped separately in a one-gallon container. Approximately three quarts of electrolyte are required for each battery. The net weight of the battery is approximately 29 pounds when dry and 38 pounds when filled with electrolyte.

A good standard hydrometer is required to measure the specific gravity of the electrolyte. A battery syringe is convenient for filling the cells and for adding electrolyte and water.

The following steps should be followed in placing the dry-charged battery in service:

(1) Unscrew the vent plugs and remove the vent seals.

(2) Fill each cell with sulphuric acid electrolyte furnished with the battery at a temperature between 32° and 100° F. to a level ½ inch above the separators. If the electrolyte must be prepared, use acid and water containing a minimum of impurities to make an electrolyte having a specific gravity of 1.275 corrected to 77° F. (See note on pages 36–37 on correction factor.)

WARNING: **Pour the acid into the water.**

(3) Allow the battery to stand at least 4 hours.

(4) Charge the battery at 2 amperes for 35 to 45 hours (70 to 90 ampere-hours).

(5) Replace the vent plugs and discharge the battery at a 7-ampere rate until the voltage, under load, drops to 12 volts per battery. This should take at least 4 hours. The specific gravity will drop to approximately 1.150.

(6) Remove the vent plugs and discharge the battery immediately at a 2-ampere rate. The charge may be started at a higher current until gassing begins and then should be dropped to 2 amperes. Adjust the level of the electrolyte to ½ inch above the separators during and after charge by adding distilled water or other water containing a minimum of impurities; then charge for 1 hour to mix the solution. Reduce the charging rate when charging at temperatures above 130° F., which will increase the charging time proportionally.

(7) After about 70 ampere-hours charge has been put into the battery, two successive hydrometer readings 1 hour apart showing no change will indicate full charge.

(8) The hydrometer will show a specific gravity of about 1.250. Add 1.275 specific gravity electrolyte and charge for about 2 hours. Repeat until specific gravity is 1.280.

(9) Replace the vent plugs, allow battery to stand 12 hours and then check the specific gravity of each cell. If the cell reads below 1.275 specific gravity, the battery *must* be rejected for service use. If the reading is over 1.285, it may be corrected by replacing some of the electrolyte with distilled water and then charging for 1 hour before rechecking.

(10) The battery is now ready for use. If not used immediately the specific gravity of each cell should be checked again immediately before use and must read 1.270 or above. If below 1.270 it must be recharged to at least 1.270 specific gravity.

The batteries are installed in the SWOD (Air Stabilizer) Mk 13 Mod 0 or Mod 1 in a wax-impregnated wooden compartment or box which is heated to provide a proper operating temperature for the batteries when used under low temperature conditions. The ⅜-inch thick walls of the compartment are grooved on the inside to reduce the contact area and to allow a convection of heat around the batteries. A 28-volt 30-watt kraft paper Westinghouse heater element ⅛-inch thick is installed in the compartment under each battery.

When placing batteries in the compartment they must be free of any foreign matter such as gravel, metal pieces, or other hard material, especially on their bottoms, and the compartment must be clean to prevent injury to the heater unit by puncture due to matter between the battery and heater. A metal clamp is provided to secure the batteries in the compartment. Care must be taken that this clamp fits onto a clean nonacid surface clear of the battery terminals and cable connections.

All connections to the batteries should be made with lead lugs properly soldered to the bat-

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tery cables. The battery terminals should be clean and free of acid before connecting the cables. Great care must be taken to prevent damage to the heater elements which will result if acid is allowed to come into contact with them. When checking the battery cells no electrolyte should be allowed to drop from the hydrometer, and the batteries must be removed from the heater compartment for charging. Be Sure the Specific Gravity of Each Cell Is 1.270 or Above Before Service Use.

In hot climates keep the batteries in a cool place, and in cold climates protect them against low temperature. In no case should they be subjected to temperatures above 175° F. nor below −40° F. Discharged batteries must be protected from freezing temperatures. At the lower temperatures the watt-hour capacity of a battery will be decreased, and at higher temperatures the over-all life of the battery will be shorter. Recharge a battery within 6 hours after it has been discharged, and every 2 weeks when standing idle. Keep the batteries clean by removing all dust, dirt, and acid with a cloth dampened with a sodium bicarbonate solution.

Any battery which shows breaks or cracks in the asphalt binding at the top of the cells may be resealed by application of a hot iron to the sealing material.

A battery may be stored without appreciable deterioration for a considerable period of time without attention in the dry-charged condition, provided the vent seals and plugs are secure.

Once the battery has been filled with electrolyte it should be kept in a charged condition.

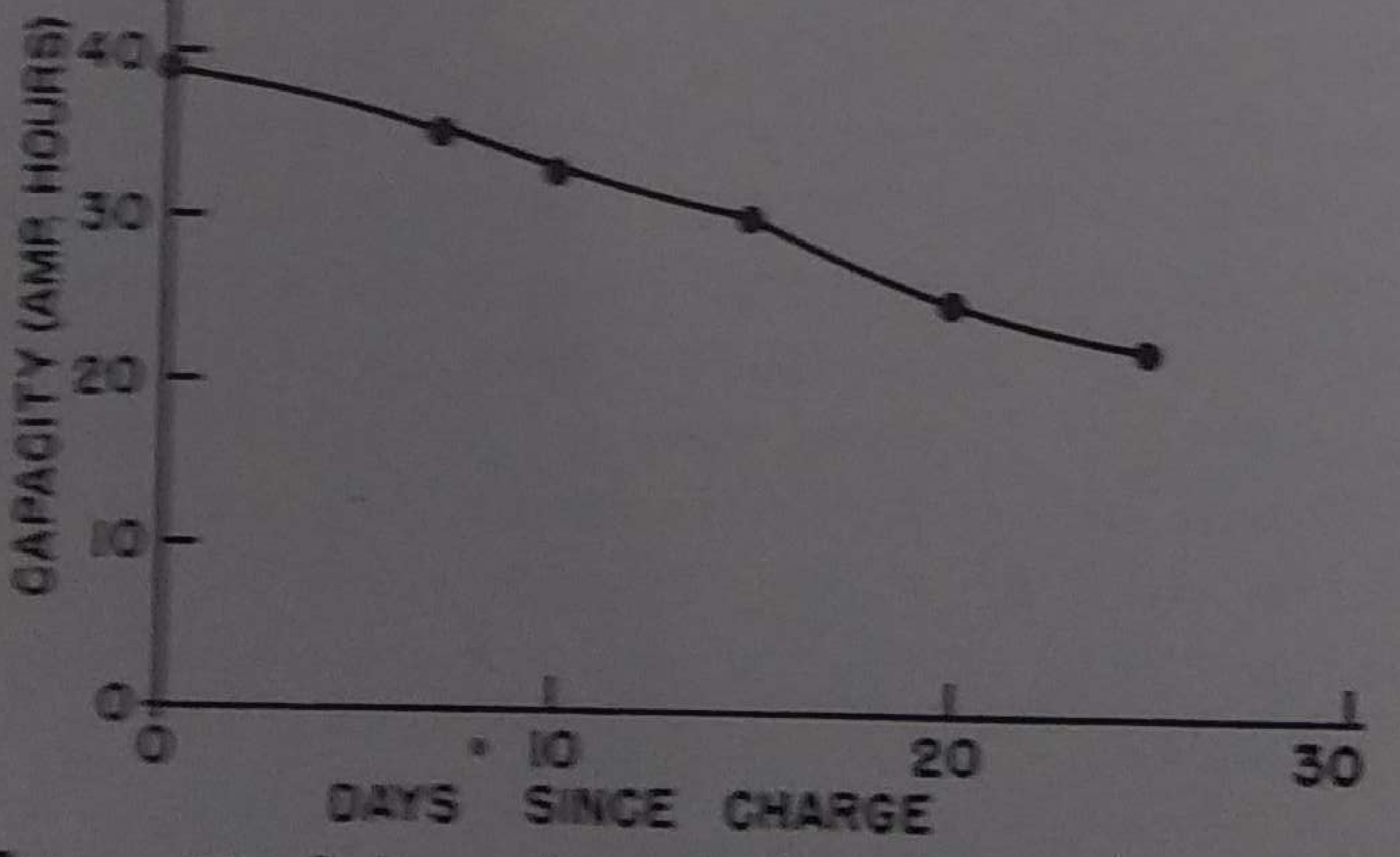

Figure 35—Relationship of Time Since Charge to Ampere-Hour Capacity of Battery.

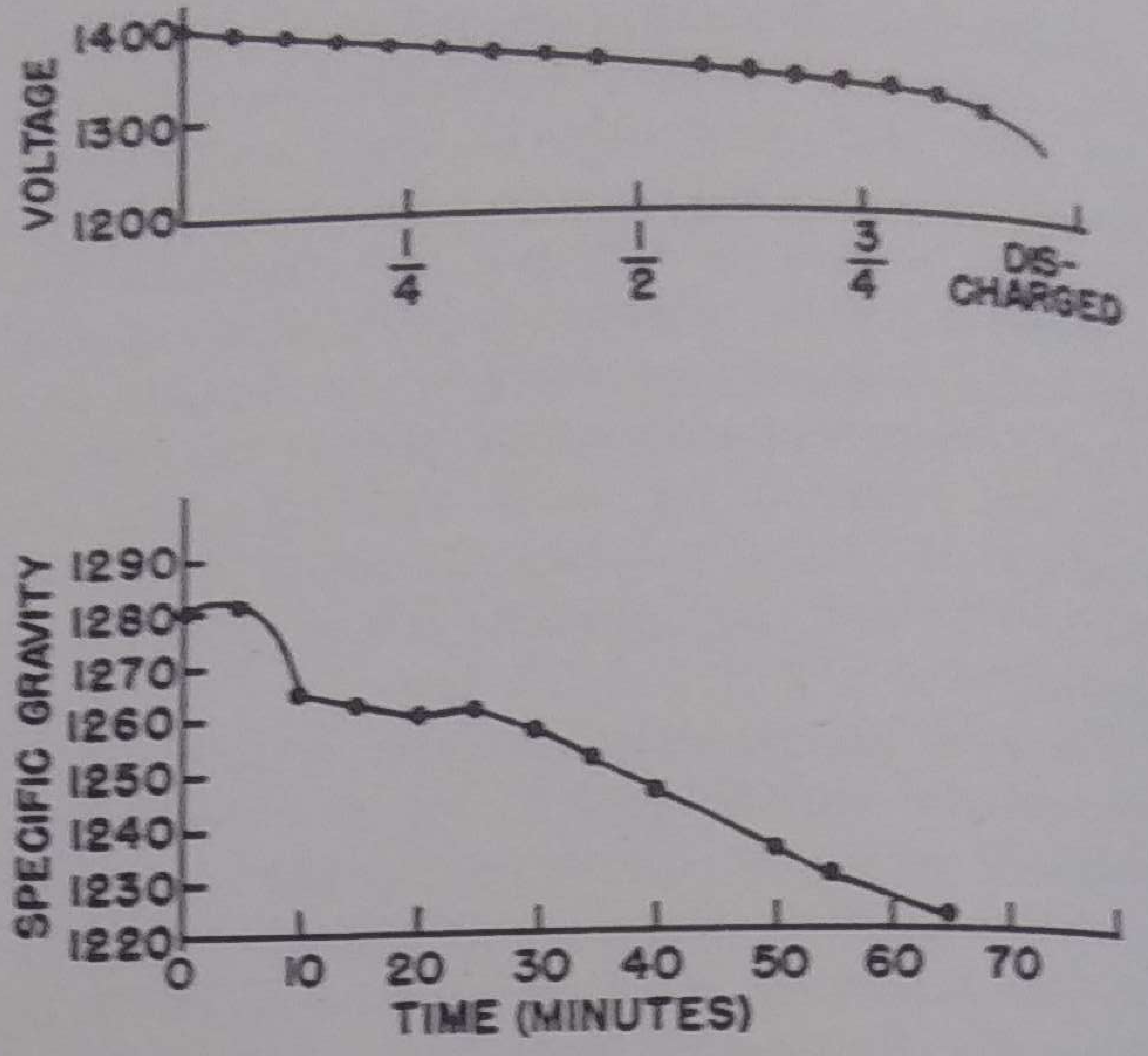

Figure 36—Change in Specific Gravity and Voltage of Battery During Discharge at 30-Ampere Rate.

An unused filled battery should be charged once every 2 weeks to maintain its charge and serviceability. Figure 35 is a graph showing the effect of storage time upon charge condition. From this graph it is obvious that a battery necessarily must be charged shortly before being put into service use if the required 1.270 specific is to be obtained.

Figure 36 is a pair of graphs showing voltage and specific gravity against time during discharge at a 30-ampere rate at 70° F. From these graphs it will be seen that a specific gravity reading of 1.270 is the best indication that a battery is fully charged.

In cases of extreme emergency 1.275 specific gravity electrolyte may be placed in a dry-charged battery and the battery placed in service use without charging. The battery will be able to supply not more than 50 to 70 percent of its rated capacity, and there will be no check to eliminate a defective battery. This procedure is to be avoided whenever possible.

Note: The specific gravity figure of 1.275 or more is given on the basis of a temperature of 77° F. To correct for temperature add 0.0004 for each degree F. above 77°. Thus, if the electrolyte temperature is 102° F. the reading of 1.265 at that temperature would correct to

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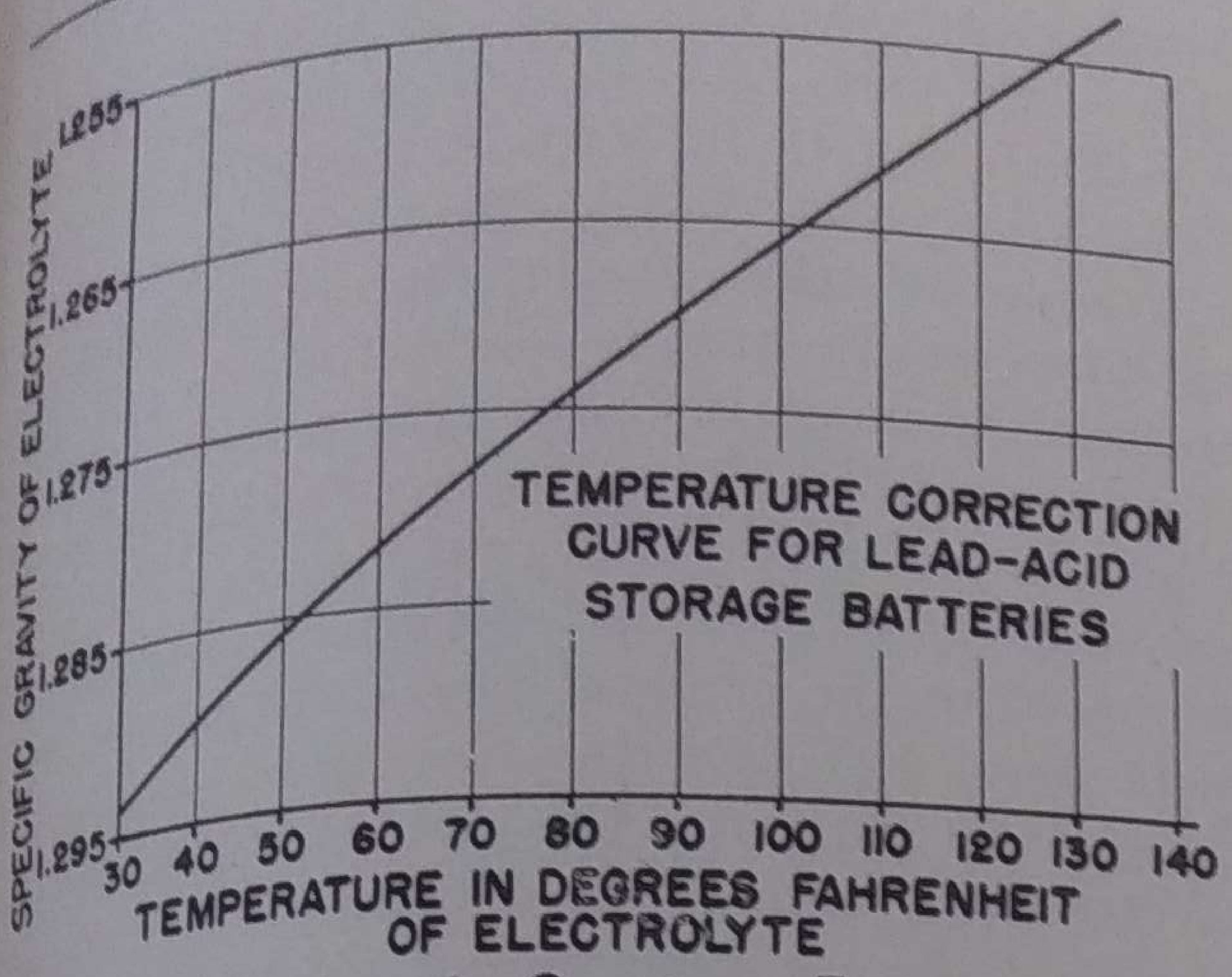

Figure 37—Specific Gravity vs Temperature.

1.275 for 77°. Figure 37 is a curve of specific gravity versus temperature for a battery at full charge.

If specific gravity checks are made while the battery is warm from charging, the temperature may be much more than 77° F. If the temperature exceeds 130°, reduce the charging rate and lengthen the time proportionately.

There is some absorption of electrolyte by the wood separators in the battery. To compensate for this, the battery should be filled with electrolyte to a level ½ inch above the plates and allowed to stand for 4 hours. If at the end of this time the level has fallen, add more electrolyte to restore the same level before charging.

It may be necessary to add a little more electrolyte to the battery after it is charged to obtain the required specific gravity reading of 1.275 to 1.285, corrected to 77° F.

6. SWOD (GYRO PANEL) MK 6 MOD 1

a. General Description

The SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN–75/DPN–1), used with SWOD Mk 9 Mod 0 only, is an automatic pilot which keeps a vehicle flying in a normal straight-line path when no signal for a change of course comes from the intelligence device, in this case the radar. When the gyro panel does receive a signal from the radar, it allows the vehicle to respond accordingly, but only in a manner which will not endanger the safety of its flight. The rate of response allowed by the gyro panel depends upon the strength of the signal received from the intelligence device. The strength of this signal depends upon the degree of error in the vehicle's flight path. Thus, if the vehicle is pointing slightly away from the desired course, the gyro panel will allow a slower rate of correction than when it points further away from the desired course. In no case, however, will the gyro panel allow a response that might endanger the stability of the missile. The gyro panel consists of three gyro units with their associated electrical and vacuum systems, mounted on a metal auxiliary bulkhead. The gyro panel is not used in SWOD Mk 9 Mod 1 since its functions have been incorporated in the SWOD (Control System) Mk 18 Mod 1 (Flight Control Servo PU–146/DPN–2).

b. Detailed Description

Theory of the Gyro Unit: In order to understand the operation of the gyro system properly, an elementary discussion of the rate gyro is desirable. A pure rate gyro differs from a free gyroscope in that motion about one of the axes is prevented by means of guides. The principal elements of a free gyroscope are shown in Figure 38. The gyro wheel rotates on pivots about an

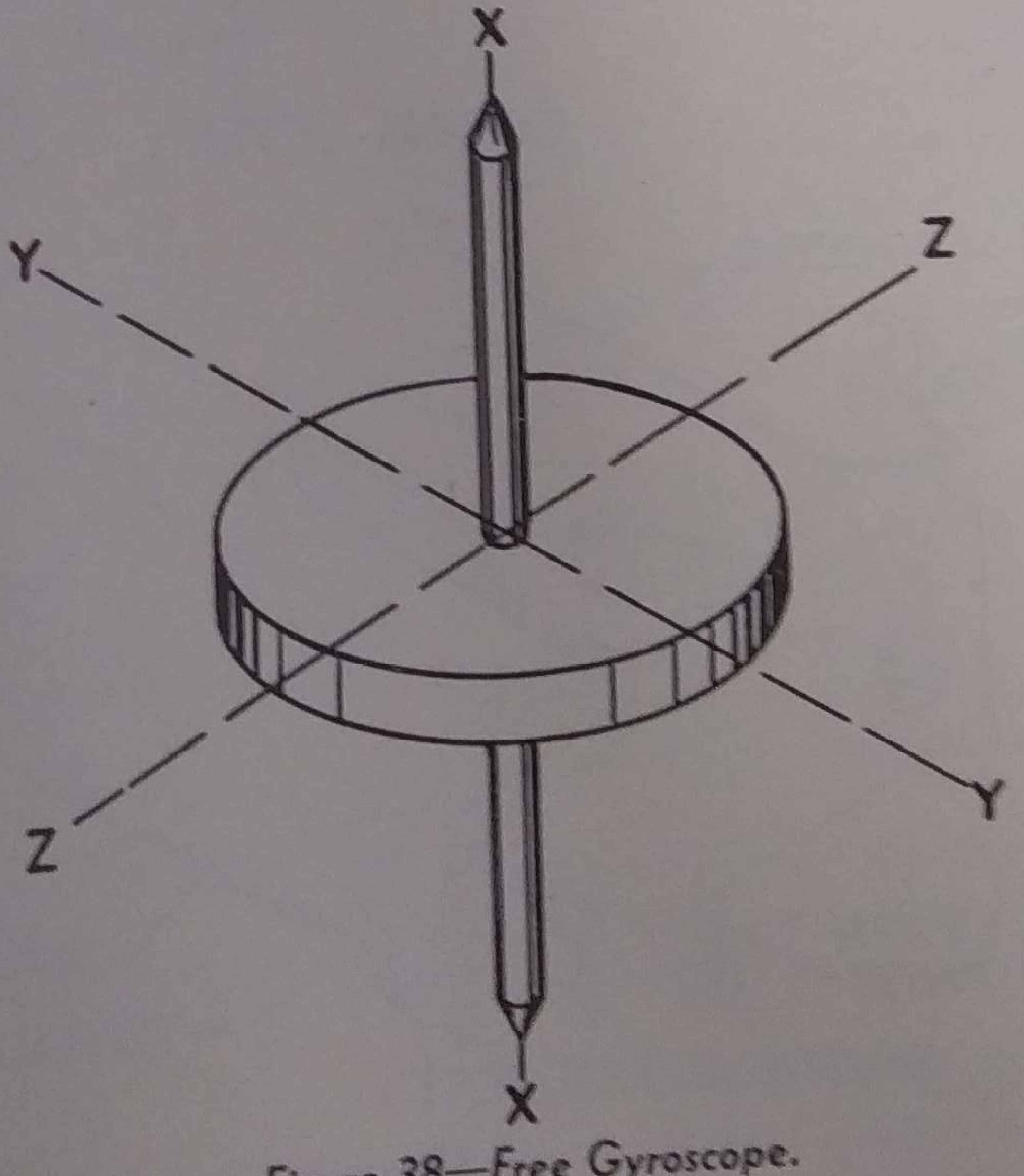

Figure 38—Free Gyroscope.

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axis X-X, and since these pivots are nearly friction-free, no effects will be caused by motion about this axis. Axes Y-Y and Z-Z are perpendicular to axis X-X and to each other, but do not rotate with the gyro wheel; all three axes maintain their orientation with respect to the shaft if the latter is revolved with respect to the Y-Y or Z-Z axis. Now suppose that the shaft is so constrained that it cannot revolve about axis Z-Z, and that the shaft is then revolved at a uniform speed about axis Y-Y by means of a suitable torque. This motion would give rise to a constant torque which would attempt to revolve the shaft about axis Z-Z, that is, attempt to precess the gyro, and the magnitude of this precessional torque would be proportional to the amount of inertia of the wheel about the axis X-X, to the rate of spin about the axis X-X (which is assumed to be constant), and to the rate of turning about axis Y-Y.

In order to utilize the intelligence developed in the form of the torque about the axis Z-Z, the practical form of the rate gyro permits motion about the axis Z-Z through a very small amplitude. While motion about Z-Z gives rise to a counter-torque about Y-Y, the latter is utterly insignificant compared to the external forces which move the shaft about Y-Y and may therefore be neglected.

Figure 39 illustrates the gyro as utilized in the SWOD Mk 9 Mod 0. The gyro wheel is mounted on an axle in a gimbal frame, which, in turn, is supported by pivots perpendicular to the rotational

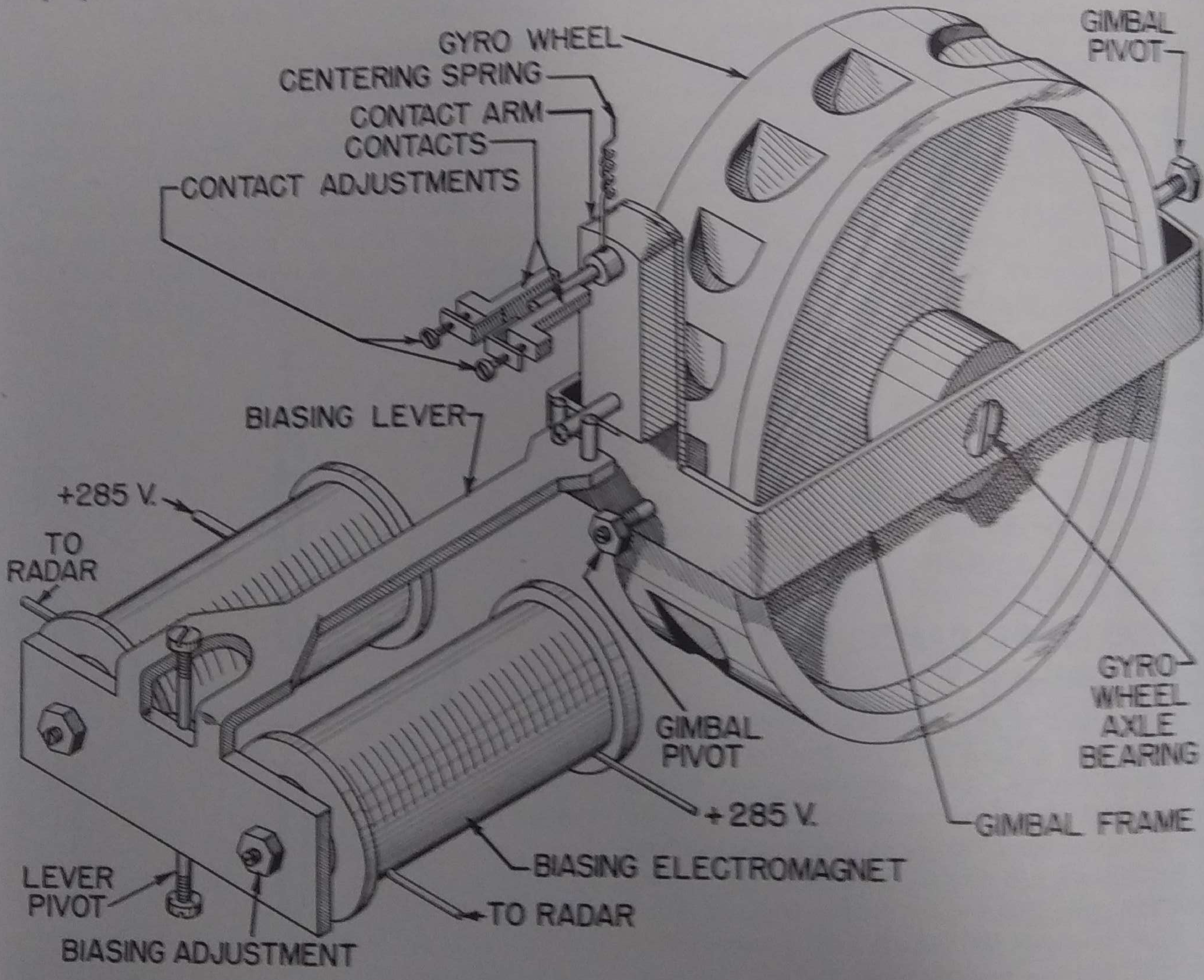

Figure 39—Rate Gyro with Electromagnetic Biasing.

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axis of the gyro wheel. Thus, the axis through these pivots, corresponding to the axis Z-Z in Figure 38, becomes the only axis about which precessional torques will be effective in producing a signal. Only these changes in orientation of the unit which have components about the vertical axis will result in a precessional torque which will act to rotate the gimbal frame on its pivots. Any axis will therefore tend to cause a movement of the contact arm attached to the gimbal frame. A constant speed of rotation of the gyro wheel is maintained by the action of a stream of air from an air jet directed against buckets in the rim of the gyro wheel.

In this application, the intelligence signal developed by the gyro system results from a combination of the gyro mechanical action discussed above and an electrical signal from the directional control circuit in the radar. To include the electrical signal, the standard Bendix gyro is modified by mounting two electromagnets and a pivot-supported level arm on the gyro head as shown in Figure 40. The action of the gyro in making and breaking contacts on either side of the contract arms is thus influenced by a mechanical bias from the two opposing biasing electromagnets as illustrated in Figure 39.

The biasing coils carry the plate currents of the two sides of the differential amplifier (located in the directional control circuit of the radar equipment) one through each coil. When these currents are equal, due to the absence of a control signal from the radar intelligence, the biasing electromagnets present equal and opposing forces to the mechanical linkage, resulting in no biasing torque being applied to the gimbal frame. Under this condition the gyro will have the only control influence upon the flight path. However, when a control signal is received from the intelligence device, the differential amplifier causes unequal values of current to flow in the two electromagnets, causing a mechanical biasing torque to be applied to the gimbal frame. This biasing torque will keep the contacts closed until the rate of change in the flight path becomes sufficiently great to develop a counterbalancing precessional torque.

An increase in the intensity of the control signal will cause a greater differential in amplifier plate currents and a greater biasing torque. Therefore, the degree of control of the flight path exerted by a control signal is a function of the signal intensity up to the point of saturation of the differential amplifier circuit. This saturation point is adjusted so that maximum differential current will not produce a mechanical biasing torque greater than the precessional torque of the gyro at maximum safe rate of change in course, in order to insure the safe flight of the vehicle. Individual gyro units are rated in degrees per second rate of turn required to exactly counterbalance a given maximum current differential.

Bendix Turn-and-Bank Indicator as Modified. The gyro units used in the SWOD (Gyro Panel) Mk 6 Mod 1 are standard Bendix turn-and-bank indicators modified by omitting the indicating mechanisms and installing contacts and an electromagnetic biasing assembly. Figure 40 is a cutaway view of such an instrument as modified.

The gyro wheel is propelled at a constant speed by the action of the Venturi tube system connected at the outlet. The pressure regulator maintains the cavity pressure at 2 inches of mercury below the outside atmospheric pressure. Air entering through the air filter passes through a jet and propels the gyro wheel by striking the buckets on the rim of the wheel. The gyro wheel is mounted on permanently lubricated ball bearings in a gimbal frame which is supported perpendicular to the rotational axis of the wheel by two pivots. Attached to the gimbal frame is a mounting plate supporting an insulated contact arm moving between two contact points. The damping piston and the centering spring which are normally used to center the contact arm and damp the gimbal frame are no longer used and therefore have been removed. See d, Improvements, p. 43. The gyros which have been thus modified are stamped with a rectangular yellow mark near the name plate.

Mechanical biasing is applied to the gimbal frame by the biasing lever which responds to any differential in current through the biasing electromagnets.

Application of Gyro Stabilization: Three gyros are employed in the SWOD (Gyro Panel)

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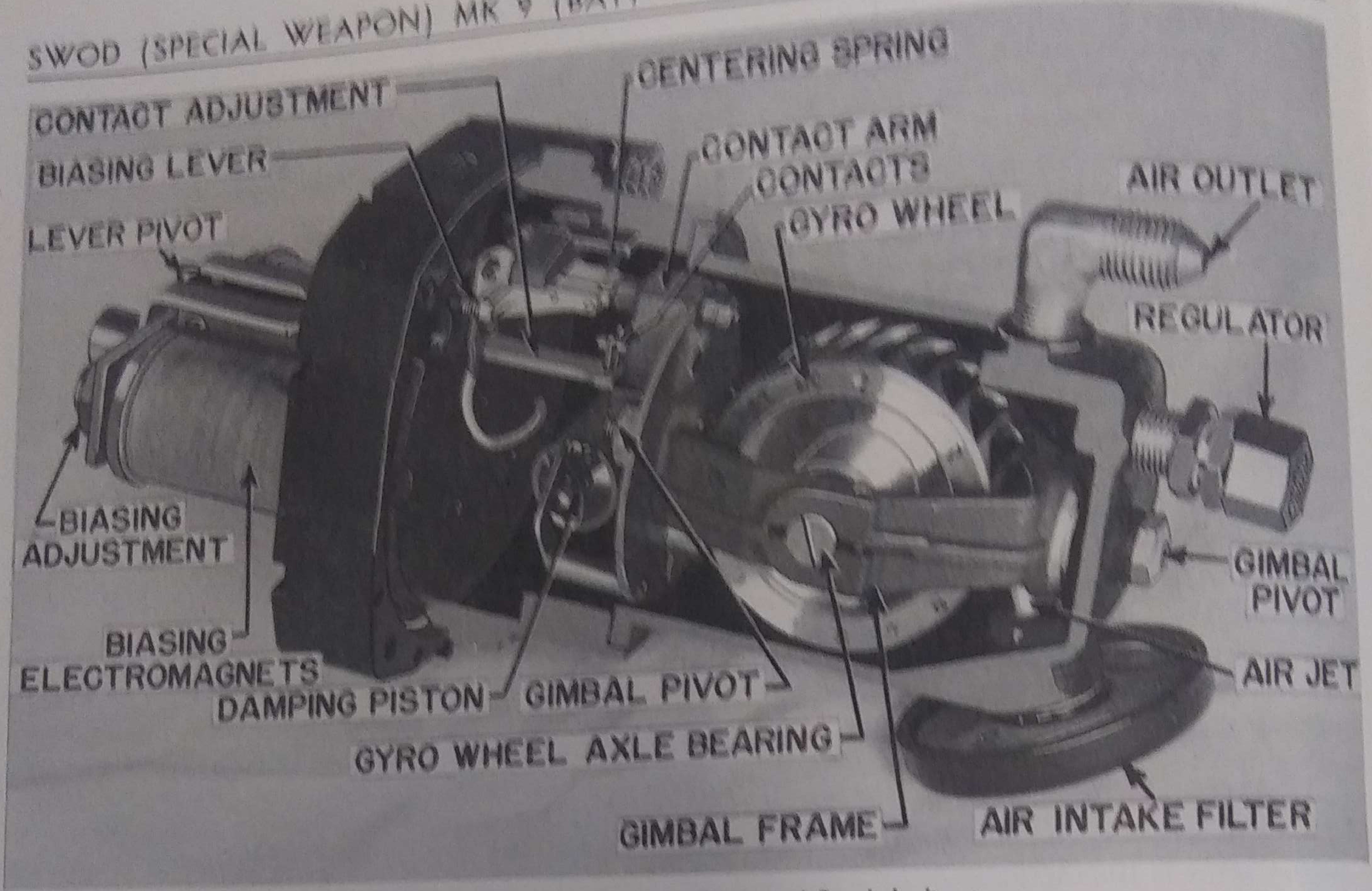

Figure 40—Modified Bendix Turn-and-Bank Indicator.

Mk 6 Mod 1: A bias gyro which is sensitive to turn only, a pitch gyro, and a turn gyro which is also partially sensitive to roll.

Roll or bank is the motion of the vehicle about its fore-and-aft axis as shown in Figure 41–A. A gyro, to be sensitive to roll, should be mounted with its gyro wheel axis of rotation in a horizontal plane perpendicular to the longitudinal axis of the vehicle as in the case of the turn motion, but with its gimbal frame supported along the vertical axis.

Pitch is the motion of the vehicle about the horizontal axis perpendicular to its fore-and-aft axis as indicated in Figure 41–B. The pitch gyro is therefore mounted with the axis of rotation of its gyro wheel vertical and its gimbal frame suspended parallel to the fore-and-aft axis of the vehicle. It thus reacts to pitch motion alone.

Turn or yaw is the motion of the vehicle about its vertical axis as indicated in Figure 41–C. A gyro, to be sensitive to turn, should therefore be mounted with the axis of rotation of its gyro wheel horizontal and perpendicular to the fore-and-aft axis of the vehicle, and its gimbal frame suspended parallel to the fore-and-aft axis, thus reacting to turn or yaw motion.

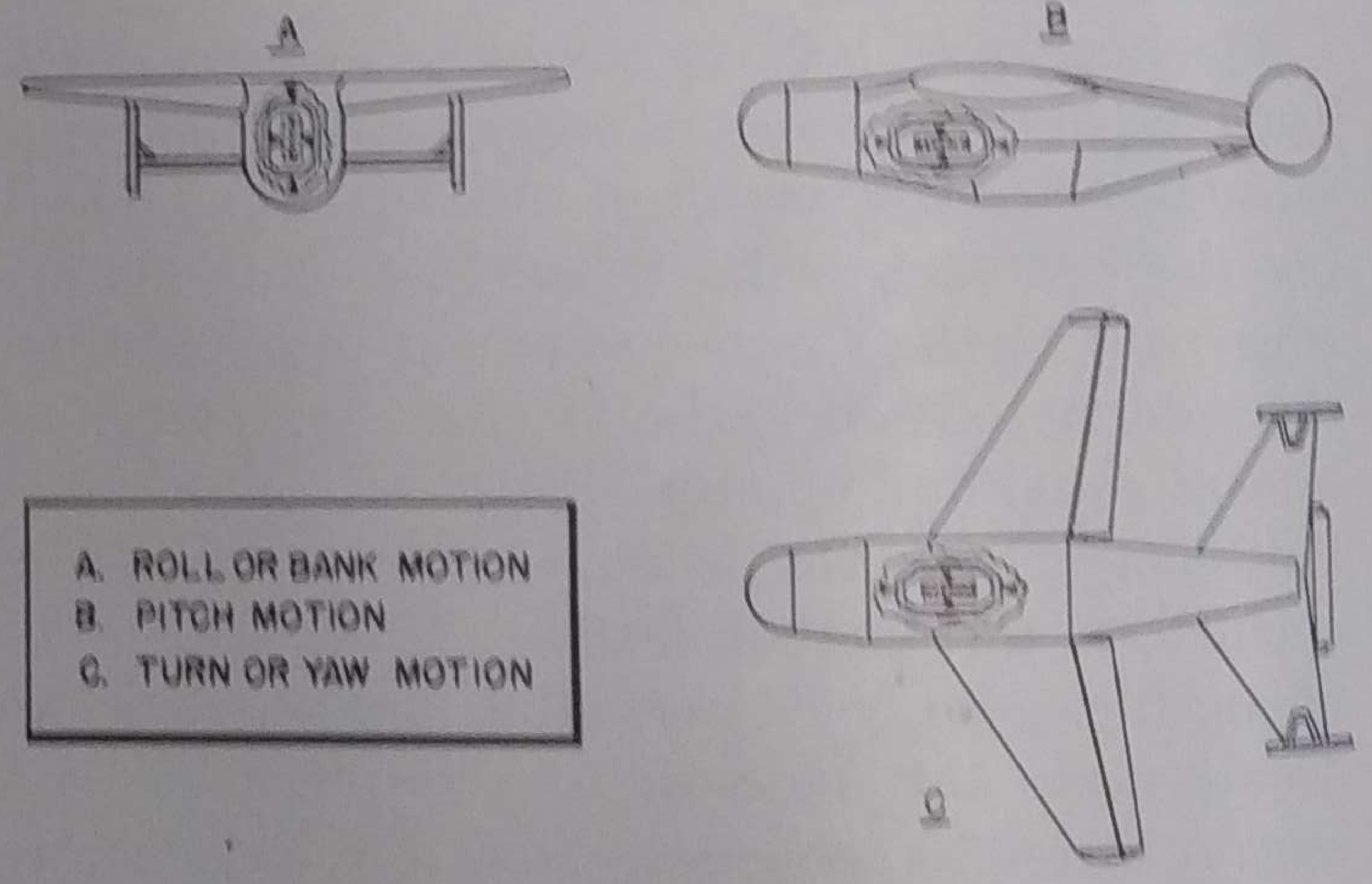

Figure 41—Axes of Rotation of Gyro Wheel to be Sensitive to Pitch, Turn, and Roll Motions.

The principal difference between a gyro sensitive to turn motion and one sensitive to roll motion is in the axis of suspension of the gimbal frame. As this axis is changed from the horizontal toward

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the vertical, the gyro will become less sensitive to turn and increasingly sensitive to roll. Therefore, one gyro may be made sensitive to both turn and roll, the proportion of sensitivity to each motion being determined by the angle of the gimbal frame axis with respect to the fore-and-aft axis of the vehicle. This angle is adjusted in practice so that turn sensitivity is considerably greater than roll sensitivity, the optimum value being that which gives most satisfactory flight. (Angle T in Figure 42.)

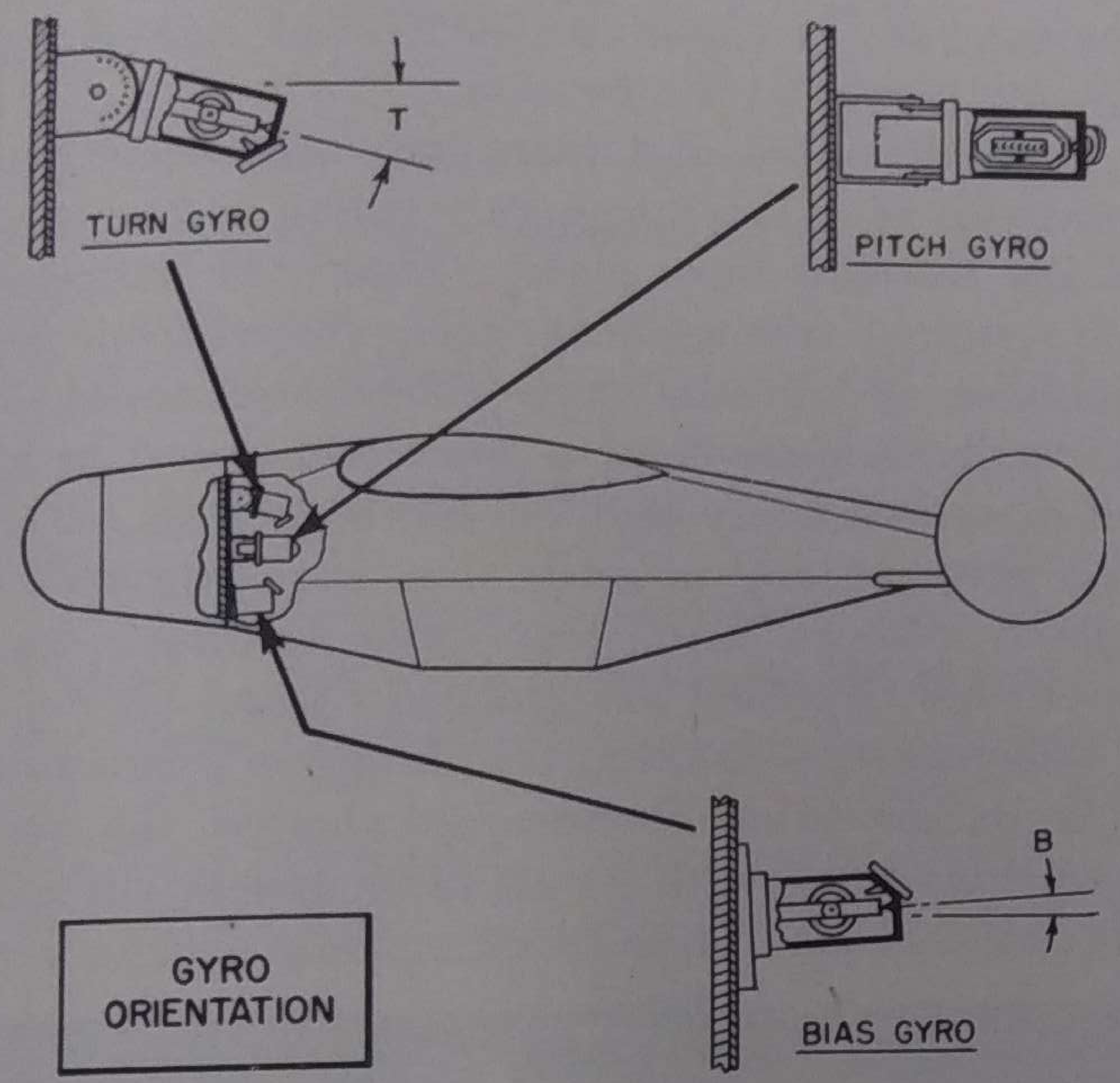

Figure 42—Gyro Orientation.

The bias gyro is employed to provide a damping effect upon the action of the turn gyro for the purpose of minimizing "hunting" or oscillation about the desired flight path. This bias gyro is the same type as the others except that the biasing electromagnets and their associated mechanical linkage are omitted, and the contacts are adjusted to require a somewhat greater precessional torque to close them. The bias gyro contacts are connected in such a manner that they will place a 5000-ohm resistor, mounted inside the bias gyro unit, across the appropriate bias coil of the turn gyro. Since the contact arm of the bias gyro is connected externally to the same positive power source as the electromagnets of the turn gyro, this serves to retard the action of the turn gyro in such a manner as to reduce over-correction.

The bias gyro, through the application of the 5000-ohm shunting resistor (which is approximately equal to the resistance of the electromagnet being shunted), reduces the current to about half in the shunted electromagnet of the turn gyro. If we assume that a turn correction is called for which gives eight milliamperes in one coil and zero current in the other coil, the resulting pull will close a turn gyro contact, activating the servo mechanism. The vehicle responds first by banking, which results in a turn in the flight path. Both turn and bank are effected with some lag due to the characteristics of the mechanism and the vehicle. The bias gyro is not sensitive to roll. Since it is mounted at a slight angle from the bulkhead (Angle B, Figure 42), it is sensitive to turn only. As the turn motion increases, the bias gyro places the shunting resistor across the acting electromagnet reducing the current through it to about 4 milliamperes. As correction in the flight path is effected, the current in the opposing electromagnet increases from zero, and reaches a value, let us assume, of 2 milliamperes. During this corrective action the current in the shunted coil drops from 4 milliamperes to 3 milliamperes. Thus the resulting biasing torque on the contact arm is reduced from the original value, and this allows a smaller precessional torque (resulting from the slower rate of turn) to break the circuit. Thus the corrective signal to the servo unit is removed before full correction is accomplished. This process reduces the rate of approach to the desired line of flight and minimizes over-shooting of the desired course.

GYRO ORIENTATION: The orientation of the gyro units is shown in Figure 42.

The pitch gryo is mounted at right angles to the bulkhead with the gyro wheel axis of rotation vertical.

The turn gyro is mounted at an angle T below the horizontal with the gyro wheel axis of rotation horizontal.

The bias gyro is mounted at an angle B above the horizontal with the gyro wheel axis of rotation horizontal.

The pitch and turn gyros are supported by special adjustable mountings which allow the angle of orientation from the perpendicular with respect to the bulkhead to be set in 2½ degree steps

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to the desired value. The bias gyro is mounted on a special wedge-shaped block which supports it at a fixed angle upward from the bulkhead.

SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN–75/DPN–1) Adjustments: In the SWOD (Gyro Panel) Mk 6 Mod 1, the turn gyro is adjusted to require a 3°-per-second rate of turn to counteract a maximum current differential of 8 milliamperes in the biasing electromagnets, and is mounted at an angle of 15° (Angle T, Figure 42) below the horizontal. The pitch gyro is adjusted to a 6°-per-second rate of turn (when the tail elevators are installed) to counteract a maximum current differential of 8 milliamperes, and is mounted perpendicular to the bulkhead. The gyro is originally furnished for a 2° rate but is modified at the modification center. The bias gyro is mounted at an angle of 3° (Angle B, Figure 42) above the horizontal.

Assembly: The SWOD (Gyro Panel) Mk 6 Mod 1 Gryoscope Assembly CN–75/DPN–1 consists of the three gyro units installed on a metal auxiliary bulkhead plate with their associated Venturi tube, surge chamber, tubing, wiring, and connectors as illustrated in Figure 43.

The Venturi tube is attached to the edge of the metal auxiliary bulkhead so that it projects out into the air stream and thus produces a suction by the movement of air through it. It is connected by tubing to a surge chamber which serves to equalize the suction applied to the gyros. Each gyro unit is also connected by tubing to the surge chamber to obtain the suction necessary to propel the gyro wheel. A pressure relief valve on the gyro maintains a 2-inch vacuum.

Two cable connectors are located on the assembly, one to accommodate the cable from the junction box and one for the cable to the servo unit. A connection is also provided for the battery heater circuit which passes through the cable from the junction box and carries the hot side of the 28-volt supply to the heaters.

Both the pitch and turn gyro units have five terminals each located in two groups in the edge of the bakelite base plate. Figure 44 indicates the terminal arrangement when viewed from the regulator end of the unit. The contact arm is internally grounded to a mounting screw at G which is externally bonded to the chassis. The bias gyro, having no coils, but requiring an insulated contact arm, has three terminals, the outer ones of which are marked C_1 and C_2.

It should be noted that the turn gyro is mounted with its air filter downward, whereas the bias gyro is mounted with its air filter upward. Thus, the precessional torque resulting from a right turn

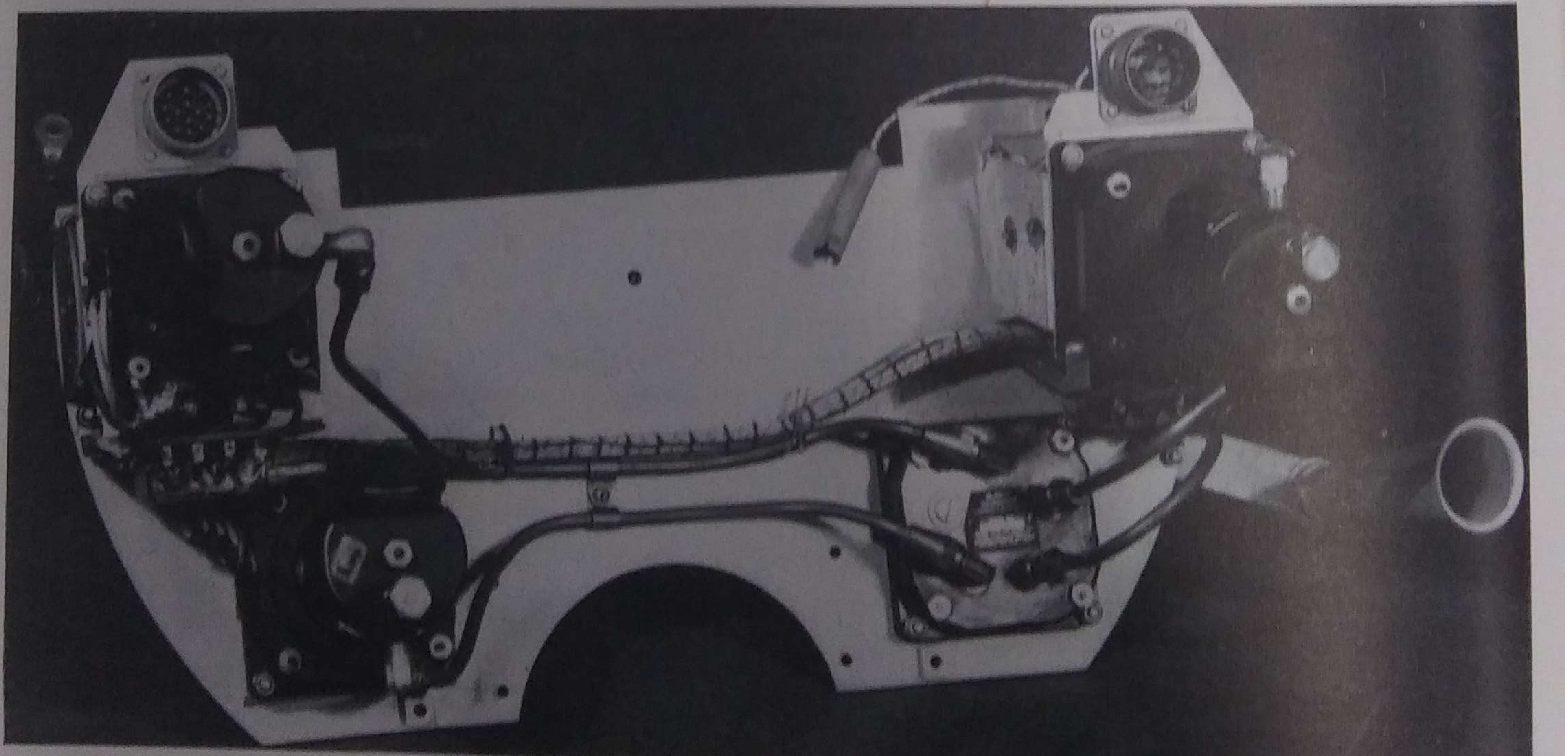

Figure 43—SWOD (Gyro Panel) Mk 6 Mod 1.

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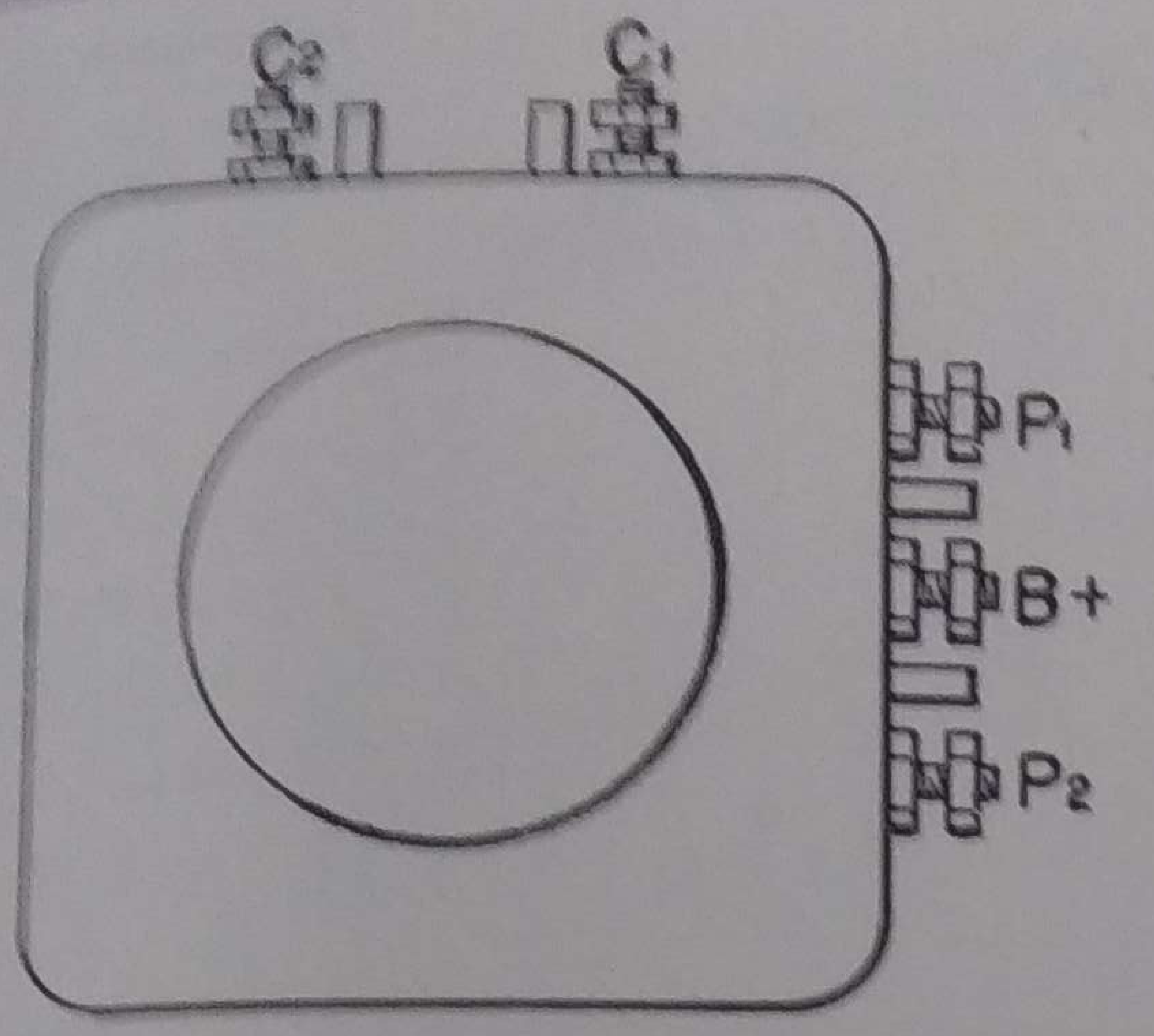

Figure 44—Gyro Terminal Arrangement.

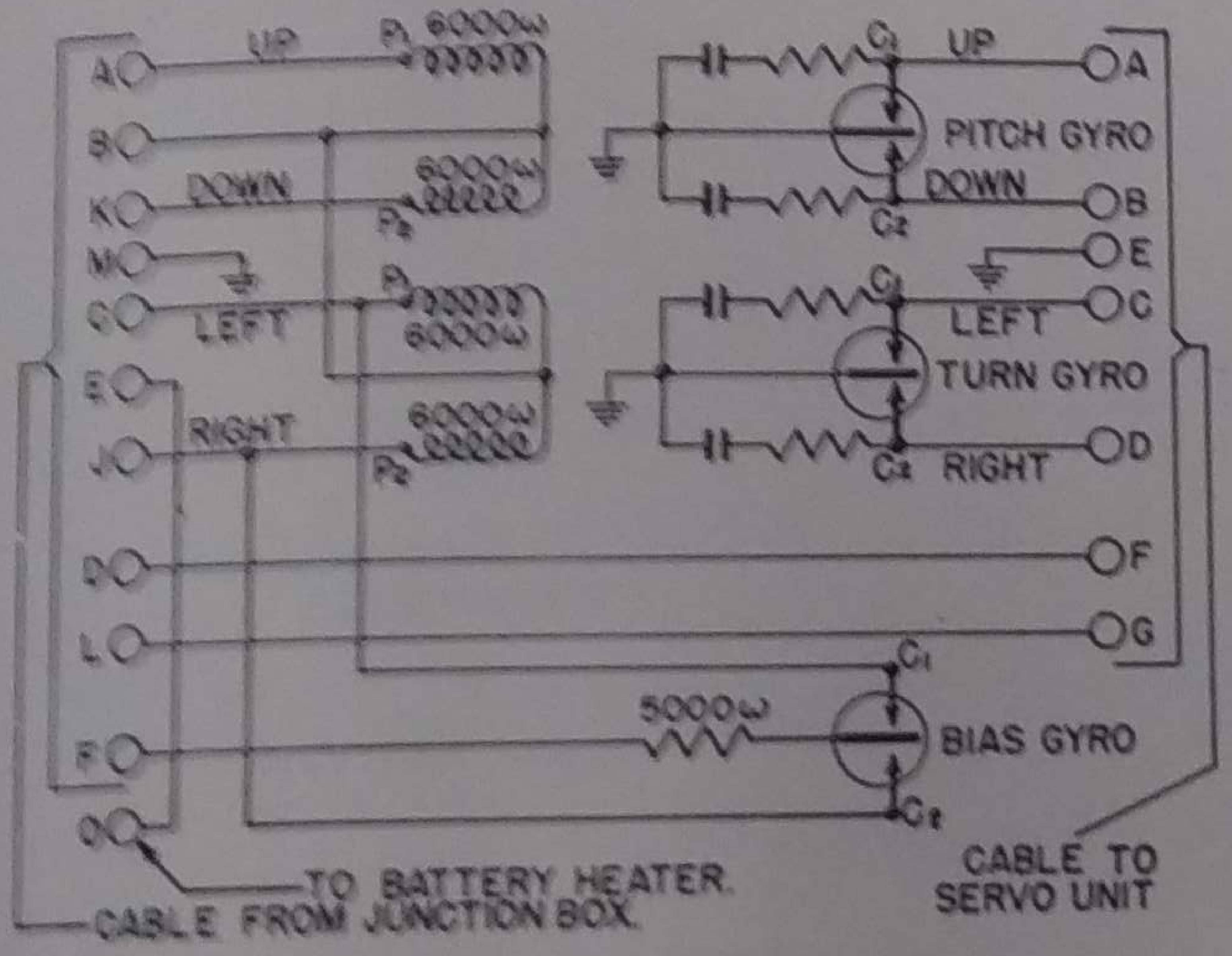

Figure 45—SWOD (Gyro Panel) Mk 6 Mod 1 Electrical Schematic.

will close contact C_1 of the turn gyro and contact C_2 of the bias gyro.

Electrical Circuit: The gyro panel electrical circuit is shown in Figure 45.

The pitch and turn gyro units have noise suppression filters, consisting of a 0.5-mfd capacitor and 100-ohm resistor in series, connected from each contact terminal to ground. These filters are mounted on small panels secured by mounting brackets to the bottom side of the pitch and turn gyro mountings. This location places the filter units as close as possible to the contact terminals.

The contacts of the pitch and turn gyros pass about 100 to 135 milliamperes of current each and have an open circuit potential of from 170 volts to approximately 220 volts across them. The current through the bias gyro contacts will not exceed 4.5 milliamperes, and the contacts will have a maximum open circuit potential of about 50 volts across them.

The contact arms of both the pitch and turn gyros connect to ground, and one end of each of the electromagnets in the pitch and turn gyros connects to the positive plate supply voltage of the intelligence device. The contact arm of the bias gyro connects through another lead of the input cable to the same positive source. A wiring diagram of the gyro system is shown in Figure 46.

c. Installation

The gyro panel is installed on the lower back side of the main bulkhead as shown in Figure 47. This metal auxiliary bulkhead is secured to the main plywood bulkhead by four bolts. The Venturi tube fits in a notch in the edge of the main bulkhead and projects out into the air stream.

All connections from the junction box to the gyro panel are made through a cable which attaches to a cable connector mounted on the upper edge of the pitch gyro. This cable carries six leads from the differential amplifier, two leads from the servo contacts of the arming switch, a ground lead and a 28-volt battery heating circuit lead which goes directly to the heater without passing through the output connector.

The output cable connector is located on the upper edge of the turn gyro and accomodates a cable which carries four leads to the servo solenoids, the two leads from the servo contacts of the arming switch and a ground lead.

d. Improvements

Improvements in the pitch and turn gyro design include the elimination of the centering spring and all centering action on the gyro gimbal-frame assembly shown in Figures 39 and 40. Gyros which include this modification will bear a rectangular yellow stamp mark near the name plate. This yellow stamp will be located so that it is visible from the top of either the pitch or turn gyro as mounted on the gyro panel. No changes are contemplated in the bias gyro.

A summary of the changes and the associated

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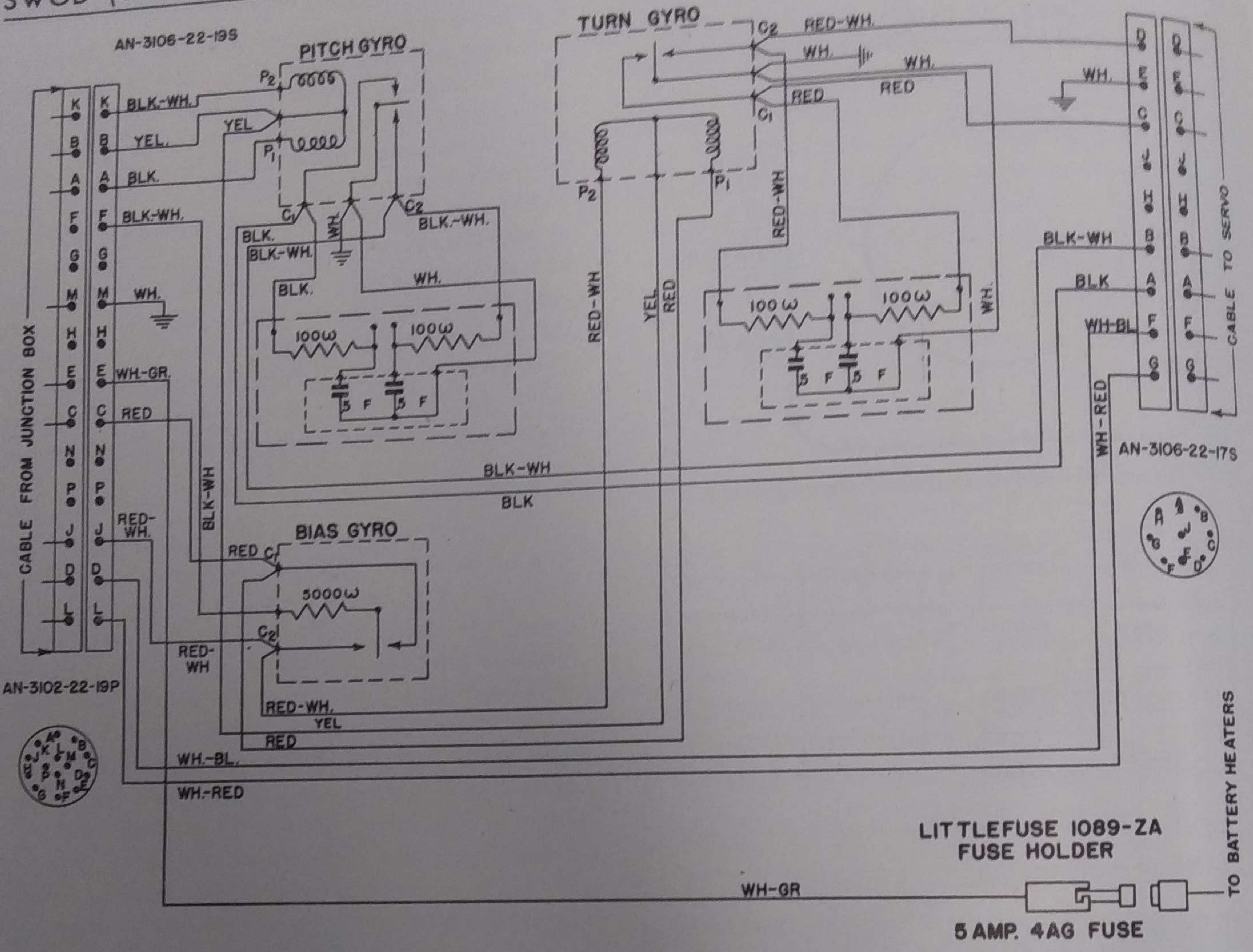

Figure 46—SWOD (Gyro Panel) Mk 6 Mod 1 Wiring Diagram.

manufacturers type number as shown on the name plate of the gyros is as follows:

Mfgrs. Type No.	Modification
(1) Types with centering spring	
1799 A	Present gyro.
1799 A–1	In this type the damping piston and cylinder are eliminated. There is no change in the test specifications.
(2) Types without centering spring. These types bear a yellow rectangular stamp mark near the name plate.	
1799 A–2	Same as 1799 A–1 except that the centering spring and all centering action on the gyro gimbal-frame assembly is eliminated. Contacts are located on the axis of rotation of the gimbal-frame to provide a suitable electric path from the gyro case to the moving control contact (ground). Mica-filled bakelite is used as the molding material for the control head in this and later models to avoid absorptions and warpage.
1799 A–3	Same as 1799 A–2 except that the gimbal bearing poles are bar bored and retained as a matched assembly and a new type of gimbal pivot bearing is employed.
1799 B	Same as 1799 A–3 except that it will incorporate an improved bearing design for the pivots of the magnetic biasing lever.

Modification of Pitch Gyro for Use With Tail Elevators: One of the modifications which is done for the improvement of the SWOD Mk 9 Mod 0 is the tail elevator modification. (See Appendix B.) In order that the pitch gyro can function properly in use with the tail elevator the

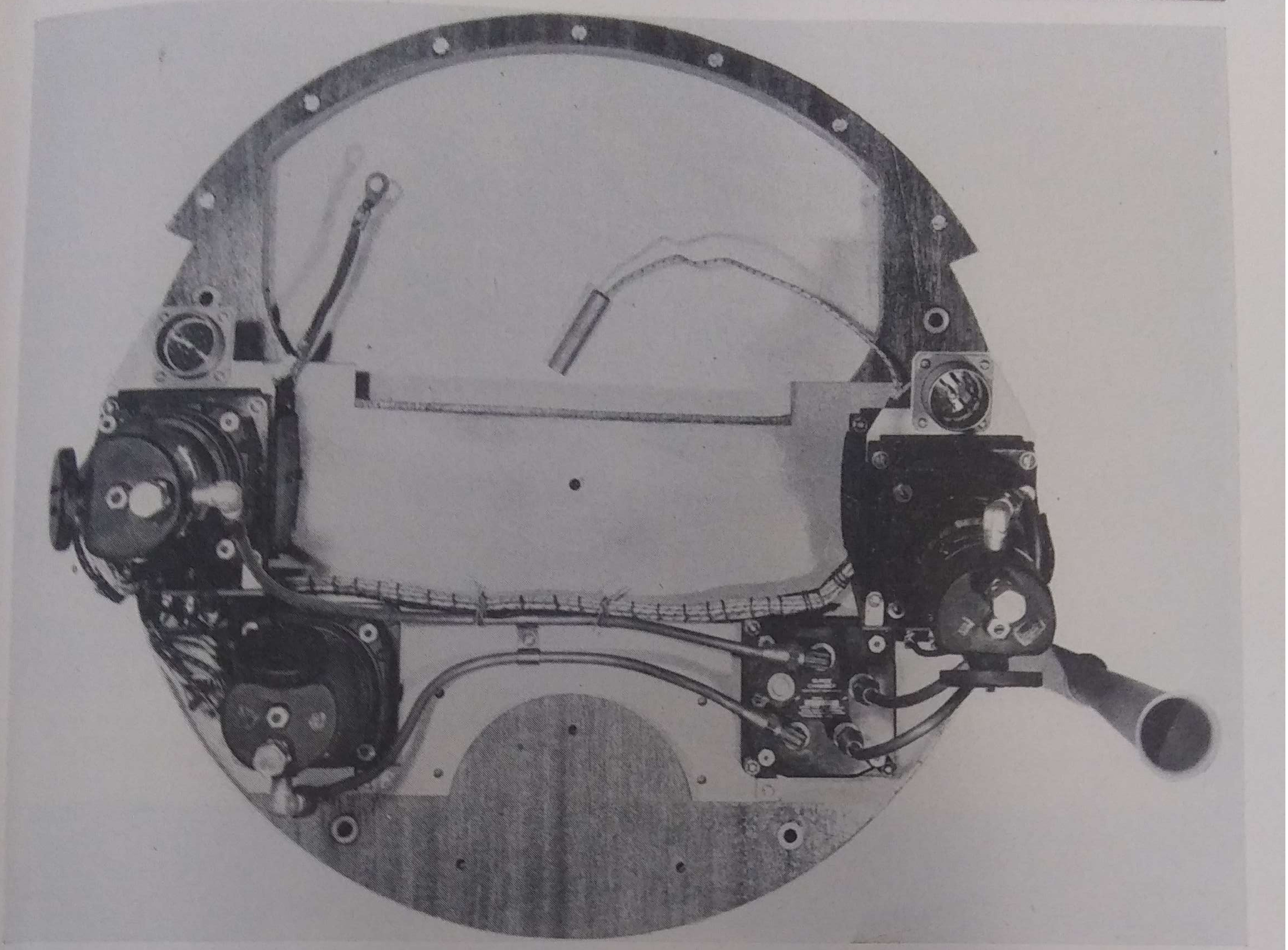

Figure 47—SWOD (Gyro Panel) Mk 6 Mod 1 Installed on Bulkhead.

2°-per-second pitch gyro must be changed to become a 6°-per-second gyro.

NOTE: This modification should be done only by personnel well qualified to do such work. It is usually done at the modification center.

The procedure for making this change is as follows:

(1) Remove the pitch gyro from the gyro panel.

(2) Remove the bakelite cover from the gyro by removing the four fillister head screws in the cover.

(3) Mark on the armature plate the position of the screw slots located in the two biasing adjustment screws. (See Figures 39 and 40.)

(4) Advance each of the two screws clockwise 1¼ turns (450°).

(5) Using the special cable provided, see Figure 48, connect the gyro terminals to the

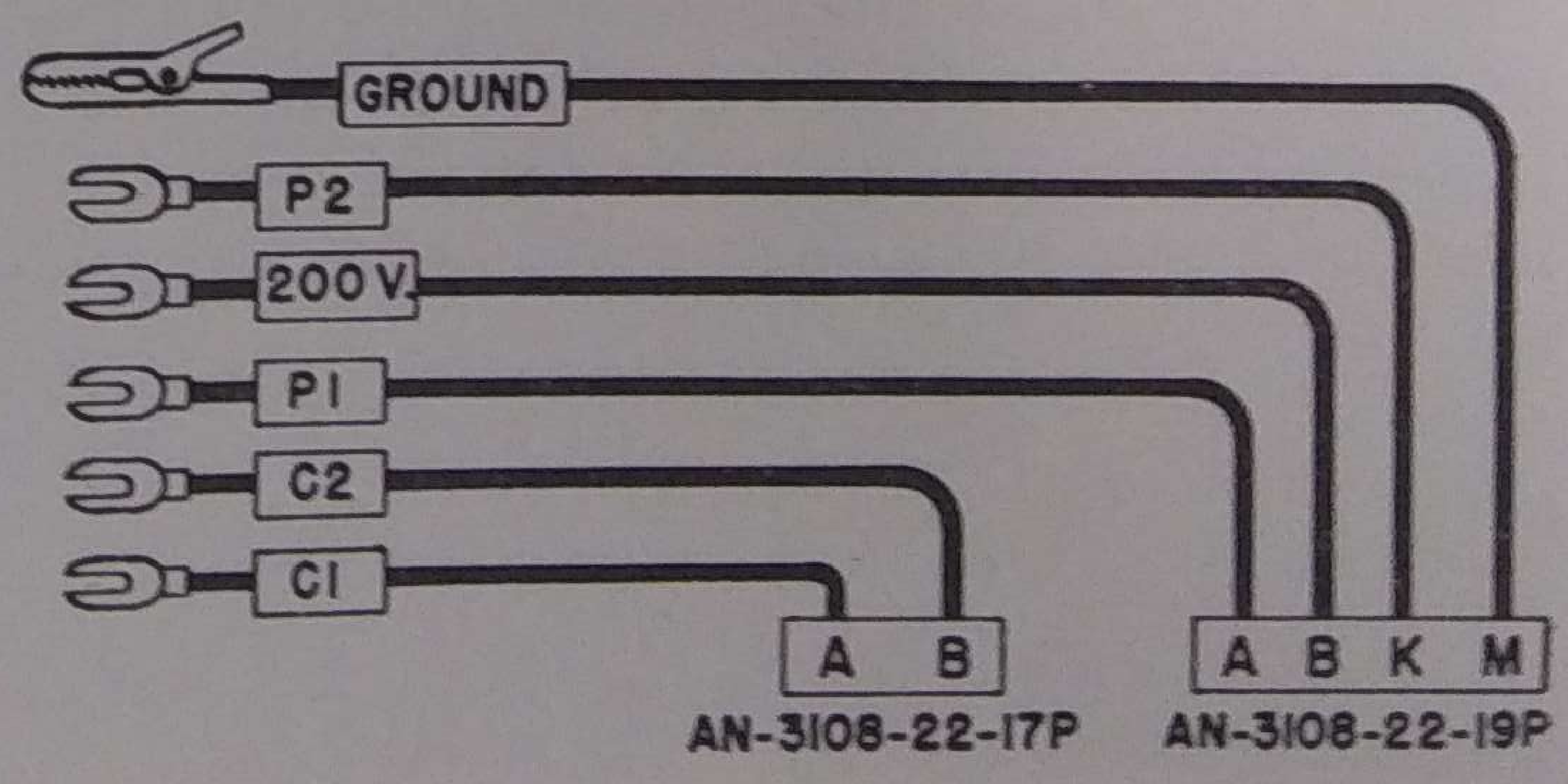

Figure 48—Special Cable for Gyro Test Unit.

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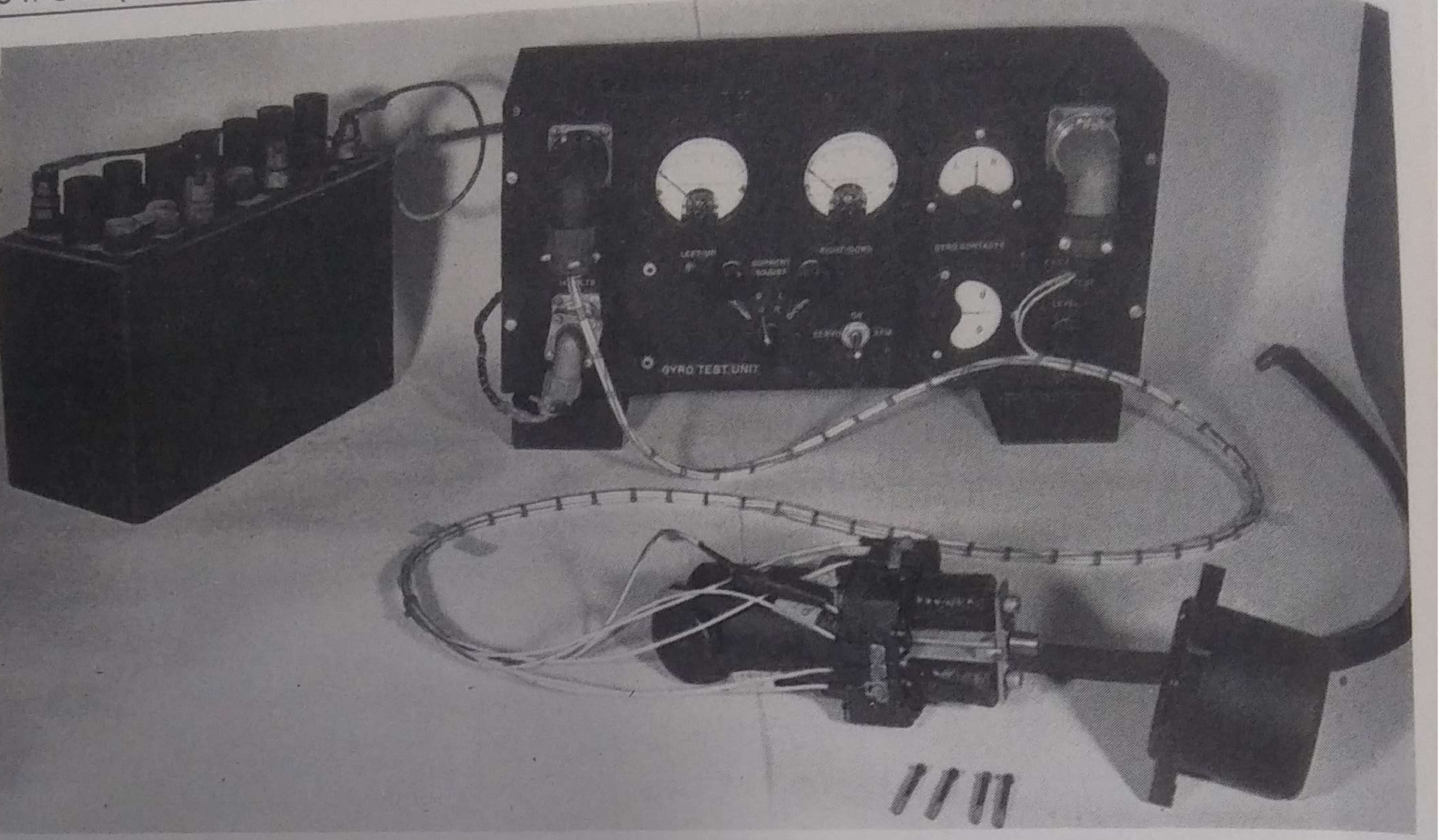

Figure 49—Connections for Testing One Gyro.

standard gyro panel checkout box as shown in Figure 49.

Note: To facilitate adjustment spin the gyro wheel by applying a slight air pressure to the gyro inlet.

(6) Hold the gyro stationary and, leaving one of the biasing adjustment screws fixed, adjust the other until the conditions of the following test are satisfied:

(a) Apply 4 milliamperes of current to one coil and 3.5 milliamperes, to the other.

(b) Increase the 3.5 milliamperes of current until the contact indicating meter in the test box indicates that the contact reverses. The current reading at reversal should not exceed 4.8 milliamperes.

(c) Now return the current to 4 milliamperes and put 3.5 milliamperes through the other coil.

(d) Increase the current until the contact reverses in the second coil. The current reading at reversal should not exceed 4.8 milliamperes.

Note: The difference between the values at which the two reversals occur should not exceed 0.1 milliampere.

(e) In case of gyros not marked with the yellow rectangular piece, the 4.8 milliampere figure should be less than 4.4 milliamperes.

(7) Make sure that the rubber sealing ring is in place; then replace the cover and mounting screws.

(8) Repeat the procedure given for test in (6) above.

(9) After satisfactory adjustment has been obtained label the gyros plainly "6°/sec."

(10) Remount gyro on gyro panel.

e. Adjustment and Testing

Adjustment and testing of turn, pitch, and bias gyros: The Nature of Adjustments Necessary on the Individual Gyro Units is Such That Special Equipment is Absolutely Necessary in Order to Make an Internal Adjustment of any Kind Whatever on Such a Unit. Under No Circumstances Should a Gyro Unit be Disassembled or Repair or

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ADJUSTMENT OF ANY NATURE BE ATTEMPTED UNLESS THE NECESSARY TEST EQUIPMENT IS AVAILABLE AND THEN ONLY BY PERSONNEL QUALIFIED TO MAKE SUCH ADJUSTMENTS.

The gyro system components and the assembly as a whole must meet definite electrical and mechanical requirements in order that balanced operation and standard performance may be obtained.

If the necessary equipment is available and it is desired to make adjustments on gyro units, these adjustments must be made in strict accordance with the standards and procedures described in the test specifications for turn, pitch, and bias gyros.

TEST EQUIPMENT FOR GYRO PANEL: Before installation in SWOD (Air Stabilizer) Mk 13 each SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN-75/DPN-1) should be tested with a gyro panel test unit, shown in Figure 50, to insure that the assembly is functioning properly insofar as can be determined within the capabilities of the test unit. For detailed information on the gyro test unit, its construction and operation and for information on other associated devices required for its use see section 7, pp. 48-55.

The gyro panel test unit is used to check the gyro panel for proper contacting and continuity of all electrical circuits, the precessional action during rotation, the effects of current differentials in the turn and pitch gyro electromagnets, and the functioning of the bias gyro. The gyro panel is mounted during test so that it may be held stationary or rotated to simulate pitch or turn motion as required by individual tests.

The check-out procedure outlined in Section 7b should be followed in checking a SWOD (Gyro Panel) Mk 6 Mod 1, and a record of the check should be made on the proper check-out sheet provided for that purpose. This check sheet is shown in Appendix D.

ALTERNATIVE CHECK-OUT PROCEDURE: The gyro panel may also be checked after installation in the vehicle by using the gyro panel test unit and a source of suction. The same check-out procedure is used except that the test unit cables are connected to the gyro panel while it is in place in the vehicle, and the vehicle itself is moved to

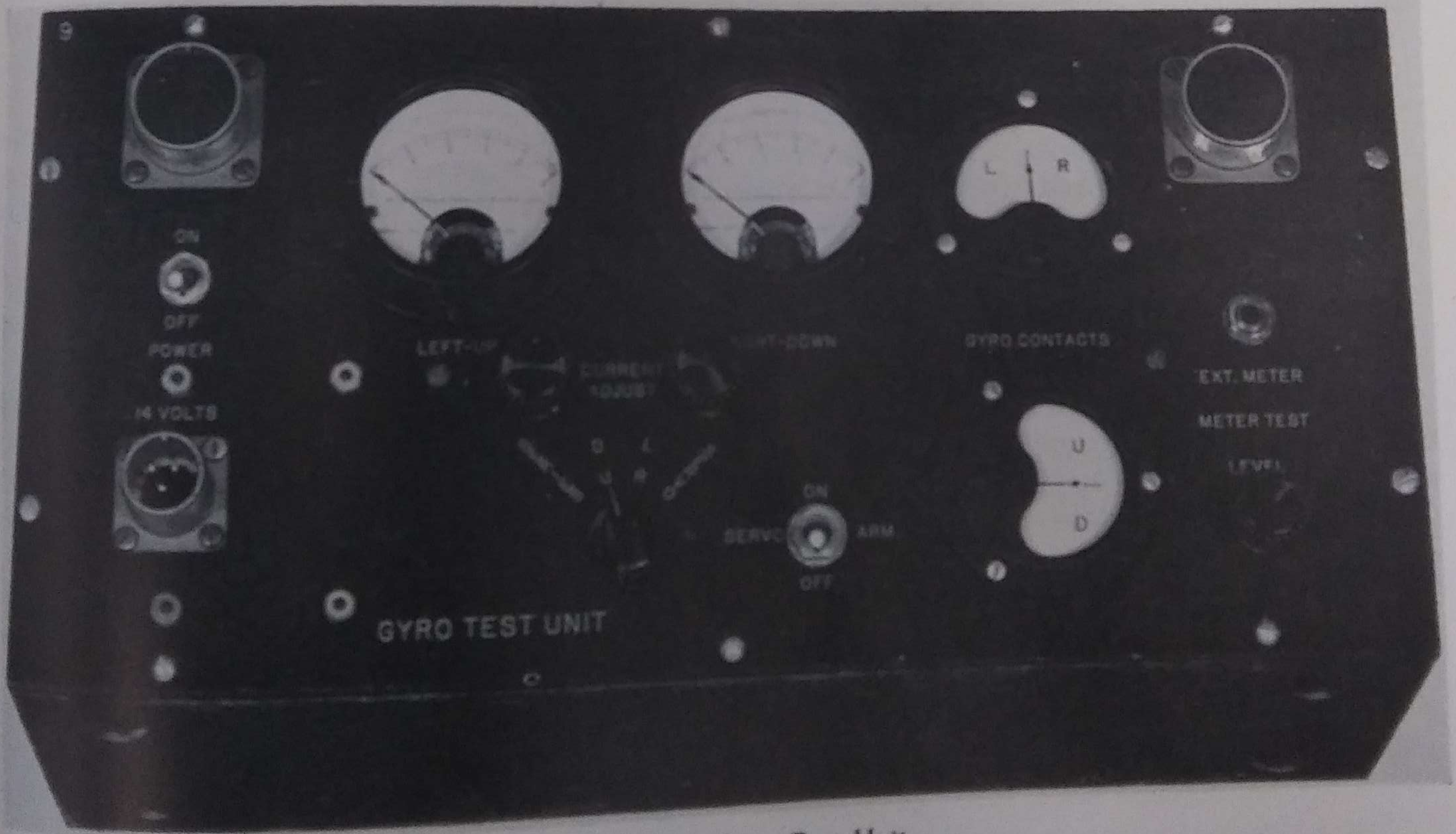

Figure 50—Gyro Test Unit.

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simulate pitch and turn motions as required. It is desirable to make this check in the vehicle before service use.

f. Care and Maintenance

It cannot be too strongly stressed that the SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN–75/DPN–1) contains gyro units which must be handled with as much care as normally would be given a precision electrical meter. While the units can withstand the mild shocks they will receive in transportation and normal use, they cannot be dropped or otherwise mistreated. A unit that has been dropped even a few inches with a direct jar should be replaced. This unit is delicate because the relatively large mass of the gyro wheel and gimbal frame is supported on the fine gimbal frame pivots. Bending or denting of these pivots will cause inaccurate and unsatisfactory operation. Normal care should be exercised in the handling and packing when shipped separately, and when the entire assembly is shipped it should not be subjected to dropping or rough handling.

The gyro assembly and individual gyro units should be stored in a clean, dry place to prevent rusting or corrosion.

Should any circuit associated with the gyro contacts become shorted, the gyro should be replaced. This is necessary because of the probability that the contacts or the centering spring (if present) which conducts the current to the contact arm may have been damaged by abnormal currents.

The gyro units will not require maintenance under normal conditions. However, in cases of abnormally long periods of storage (in excess of 1 year), they should be relubricated and readjusted.

The regulator and air filter air intakes should be kept clean and unobstructed; all masking tape that may have been placed over the regulator during assembly should be removed before installation.

7. GYRO TEST UNIT AND CHECK PROCEDURE

a. Description

The gyro test unit provides a means of checking the SWOD (Gyro Panel) Mk 6 Mod 1 as an assembly and is designed especially for use in the field to provide a final check of the electrical and gyroscopic systems. It is contained in a metal case, shown in Figure 50, which measures 16½ by 8 by 6½ inches and weighs 14 pounds. Four cables are supplied with the unit. The following three are used in checking the gyros after installation in the air stabilizer.

Power Cable: A 6-foot, 2-wire cable with an AN–3108–16–108 connector on one end to fit the 14-volt connector on the gyro test unit panel, and a pair of small alligator clips on the other end. These clips attach to the 14-volt storage battery which energizes the unit, the red lead connecting to the positive terminal and the black lead to the negative terminal of the battery.

Input Cable: A 6-foot cable with an AN–3108–22–19S connector on one end to fit the input connector on the SWOD (Gyro Panel) Mk 6 and an AN–3108–22–19P connector on the other end to fit the connector on the left end of the gyro test unit panel. This cable has all pins connected through, letter to letter, with No. 16 wire.

Output Cable: A 6-foot cable with an AN–3108–22–17S connector on one end to fit the output connector on the SWOD (Gyro Panel) Mk 6 and an AN–3108–22–17P connector on the other end to fit the connector on the right end of the gyro test unit panel. This cable has all pins connected through, letter to letter, with No. 16 wire.

The fourth cable which is a special cable used for testing single gyros before installation connects directly from the gyro to the gyro test unit. See Figures 48 and 49.

The electrical schematic is shown in Figure 51. Two 0–to–1–ma milliammeters, provided with adjustable shunts and 0–to–5–ma scales, are used to measure the currents through the gyro coils. Two 5–to–0–to–5–ma zero-center milliammeters, in the indicating meter circuits connected to the output contacts of the pitch and turn gyros, indicate when the various gyro contacts are closed.

A dynamotor, which operates from the 14-volt battery circuit, supplies 200 volts D. C. to operate the meters and gyro coils.

The 4-pole 4-position selector switch connects the two shunted 0-to-1-ma meters (with 0-to-5-ma scales) into four different circuit arrangements, as shown in Figure 52. These are:

SERIES—Position 1 of the selector switch

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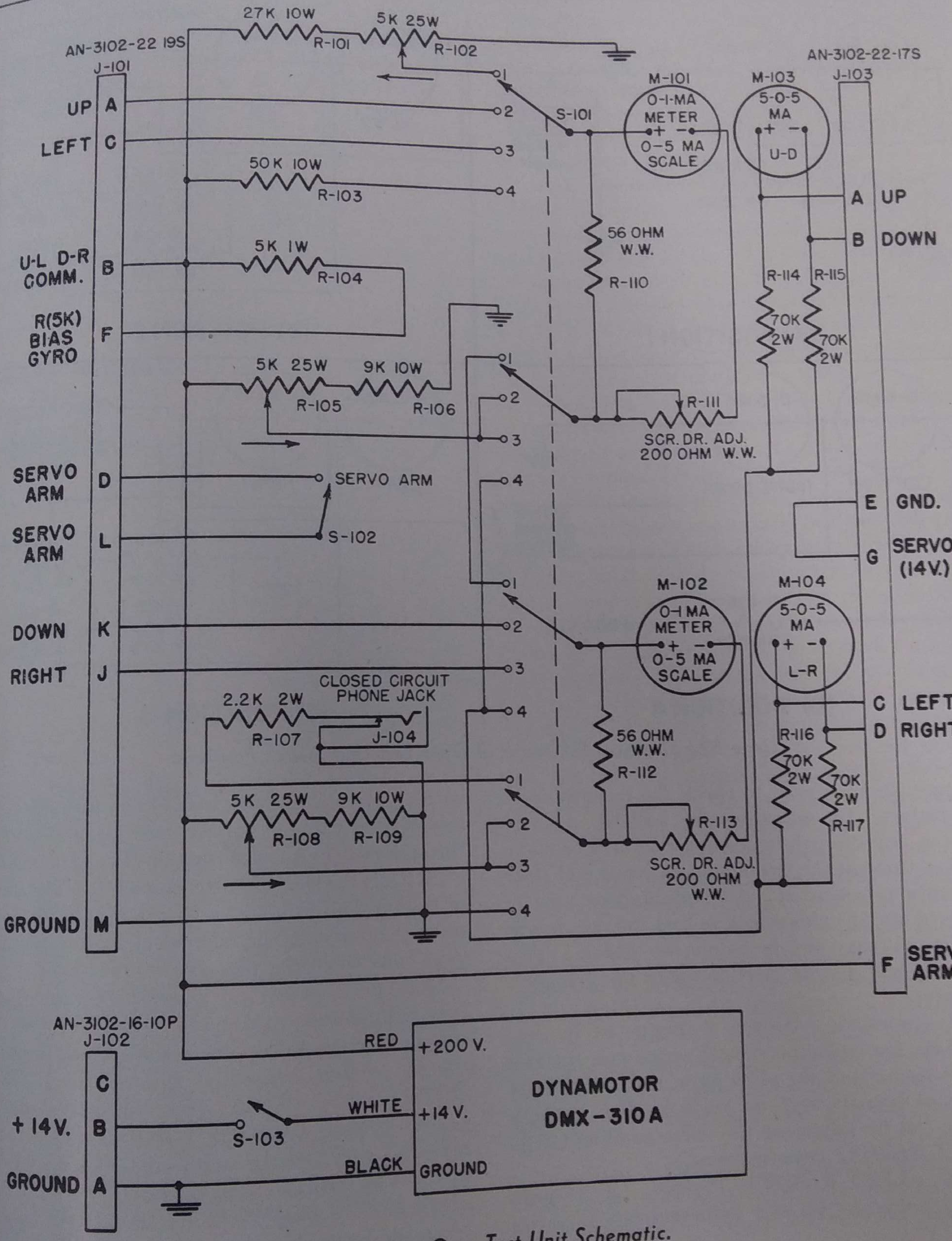

Figure 51—Gyro Test Unit Schematic.

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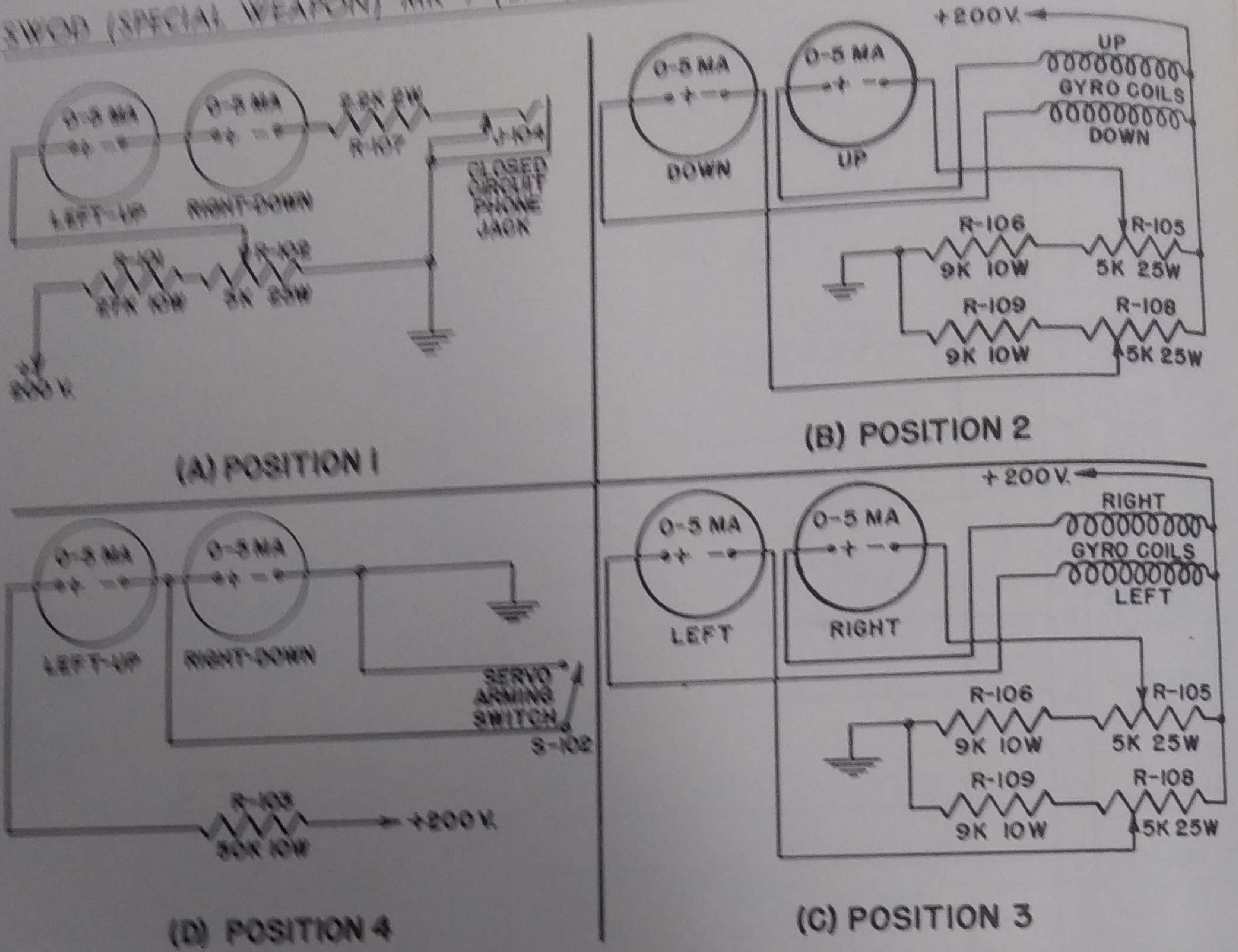

Figure 52—Electrical Schematic of Gyro Test Unit Switch Positions.

(Figure 52–A) is used to check the calibration of the meters. By adjusting the LEVEL potentiometer, any desired value of current may be made to flow through the two meters in series and their calibrations compared. A standard meter may be plugged into the phone jack so that the two meters in the unit may also be compared with it. This position may also be used to verify the bias gyro operation.

DU (DOWN-UP)—Position 2 (Figure 52–B) connects the two milliammeters in series with the two electromagnets of the pitch gyro, and any desired value of current may be made to flow through either coil by adjusting the corresponding CURRENT ADJUST potentiometer.

L-R (LEFT-RIGHT)—Position 3 (Figure 52–C), connects the two milliammeters in series with the two electromagnets of the turn gyro and any desired value of current may be made to flow through either coil by adjusting the corresponding CURRENT ADJUST potentiometer. The action of the bias gyro may also be checked in this position by observing the current change in the turn gyro coils when the bias gyro is precessed.

SERVO—Position 4 (Figure 52–D) connects the two milliammeters in series across the 200-volt supply through a dropping resistor, with the servo arming switch connected across the RIGHT-DOWN meter. Thus, when the servo arming switch is closed, the RIGHT-DOWN meter should indicate very nearly zero, and the LEFT-UP meter will indicate approximately 13 ma. Any appreciable reading of the RIGHT-DOWN meter when the servo switch is closed will indicate resis-

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ance in the servo arming circuits or grounds of the gyro panel. When the servo arming switch is open both meter readings should be equal and approximately 13 ma. Any appreciable difference indicates leakage or a short.

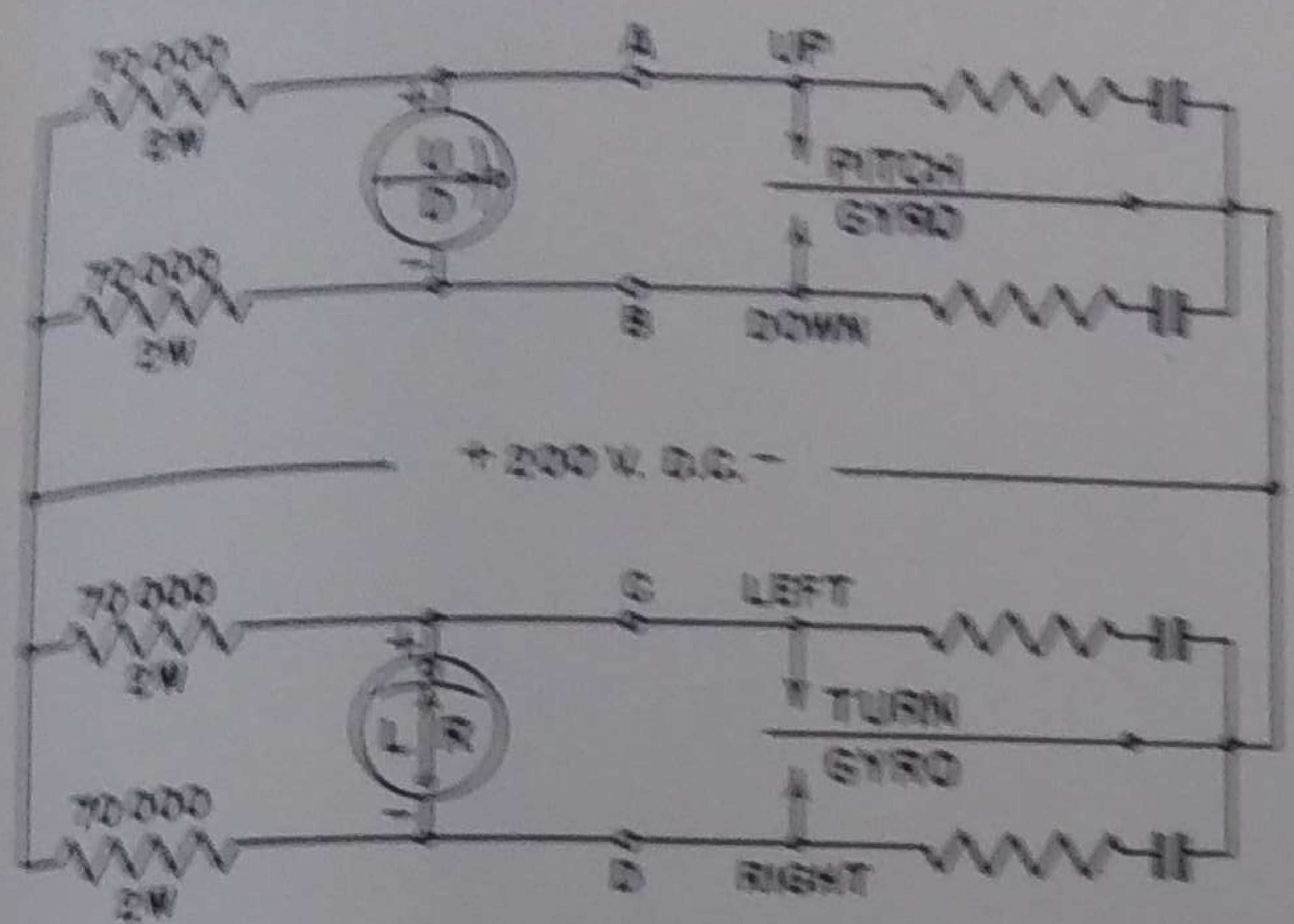

Figure 53—Gyro Test Unit Indicating Meter Circuits.

The indicating meter circuit shown in Figure 53 is arranged so that the U-D meter will indicate when one of the contacts in the pitch gyro is closed, the direction of the deflection from the zero center indicating which contact has been closed, and the average amplitude of the deflection indicating the approximate percentage of time that the contact is closed. The L-R meter is similarly connected to indicate the corresponding contacting of the turn gyro.

b. Gyro Panel Test Procedure

Equipment: The following equipment is required for the gyro panel tests:

(1) Gyro panel test unit.

(2) Vacuum cleaner or other similar source of suction, with necessary power source.

(3) 14-volt storage battery.

(4) Test mounting (unless gyro panel is installed in vehicle).

Mechanical Inspection: The following points on the gyro panel should be inspected:

(1) 15 gyro connections—tight and glyptaled.

(2) Eight gyro bracket screws—tight and glyptaled.

(3) Three air filters—hand tight and unobstructed.

(4) Eight tubing connectors—tight.

Calibration of Gyro Test Unit: The following steps should be taken to determine the calibration accuracy of the milliammeters before making the gyro panel check:

(1) Check all meters for proper zero-set.

(2) Connect the power cable to the 14-volt storage battery and close the POWER switch.

(3) Place the selector switch in the SERIES position and adjust the LEVEL control to 5 milliamperes on one of the meters. If the other meter agrees in reading within 0.1 milliampere then the units may be assumed to be in calibration. Otherwise, plug a milliammeter of known accuracy into the EXT. METER jack and adjust the CALIB. ADJ. controls inside the case until both meters on the unit agree with the known meter.

Gyro Panel Test Setup: The gyro panel must be mounted, either on a test mounting for checking the unit after assembly, or in the vehicle for a preoperational check. Figure 54 shows the gyro panel being tested before assembly on bulkhead. This check can normally be done with gyro panel mounted on bulkhead by merely holding the bulkhead in an upright position on the test table and pivoting it to represent turn or pitch motions. In either case, the mounting must permit rotation of the gyro panel in simulation of both turn and pitch motions. The gyros must be operated by applying suction to the Venturi tube. The usual method is to attach a vacuum cleaner (G. E., Electrolux or similar type) to the end of the Venturi. If the Electrolux or G. E. Vacuum cleaner is used, the front of the Venturi should be covered until the gyros get up to operating speed and then the cover should be removed. This machine should not be operated for periods greater than 5 minutes at a time with the front of the Venturi tube covered. The suction must be great enough to decrease the air pressure within all of the gyro chambers to 2 inches of mercury below the atmospheric pressure. This condition may be checked by making certain that air is being sucked into the air pressure regulator on the back of each gyro. Connect the gyro panel, using the two cables supplied with the gyro test unit.

Electrical Response: The electrical response of the gyro units in the gyro panel may be tested by causing a difference in current in the two coils

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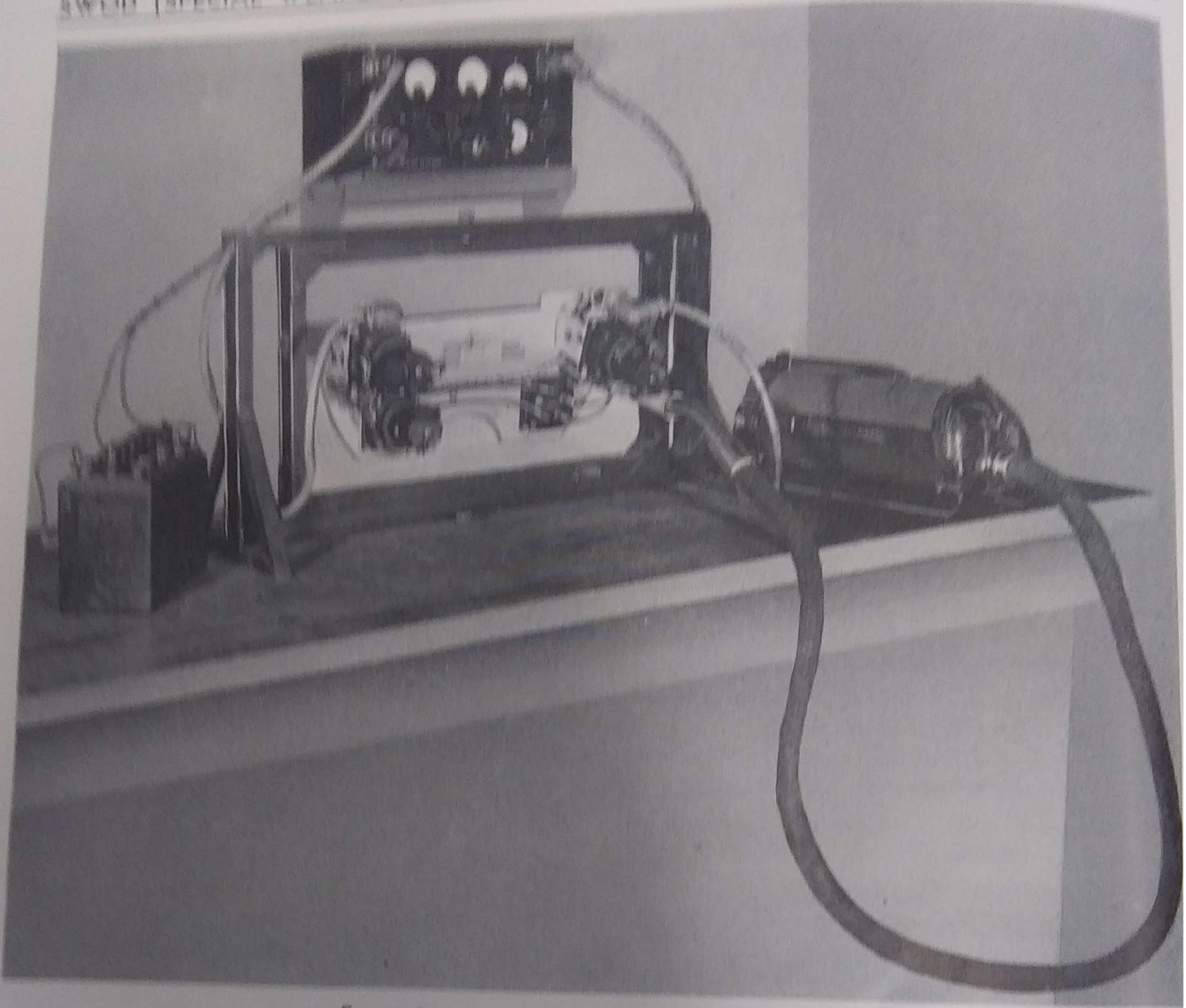

Figure 54—Connections for Gyro Panel Test.

of a gyro unit and observing the response of the GYRO CONTACTS meters. These results should be recorded on check-out sheet according to specification provided. The gyro test unit and the vacuum cleaner must be ON and the gyro wheels must be up to speed for this test, with the gyro panel stationary.

For the purposes of this test procedure, the gyro units employed as pitch and turn gyros on the SWOD (Gyro Panel) Mk 6 Mod 1 may be divided into two categories, those with gimbal frame centering springs, and those without gimbal frame centering springs.

Because of the difference in behavior of thes two different categories of gyros, it will be necessary to follow one of two different procedures i checking out the SWOD (Gyro Panel) Mk Mod 1.

For units which contain gyros in the first category, which do *not* bear the yellow rectangula stamp mark, follow the procedure marked *fo spring centered gyros* when alternative procedure are given.

For units which contain gyros in the secon category, which bear the yellow rectangular stam

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mark near the name plate, follow the procedure marked *for uncentered gyros.*

Turn Gyro:

(1) Turn the selector switch to the L-R position.

(2) Adjust the current in each meter to 4 ma.

(a) For *spring centered gyros,* there should be no indication on the L-R GYRO CONTACTS meter.

(b) For *uncentered gyros,* the L-R gyro contact meters will indicate either way, depending upon which contacts happen to be closed.

(3) Reduce the current indicated by the LEFT-UP meter until the L-R gyro contacts meter indicates R; then increase the current indicated by the LEFT-UP meter until the L-R gyro contact meter indicates L 50 percent of the time. (A reading of the gyro contact meter is considered L, for example, when the meter reads L 50 percent or more of the time.) The initial reduction of current is unnecessary in units with spring centered gyros. The current indicated by the LEFT-UP meter should not exceed 4.4 ma for uncentered and 5 ma for centered gyros.

(4) Return the current in the LEFT-UP meter to 4 ma, and decrease the current indicated by the RIGHT-DOWN meter until the L-R gyro contacts meter indicates L if the gyros are uncentered, and then increase the current in the RIGHT-DOWN meter until the gyro contacts meter indicates R 50 percent of the time. The initial reduction of current is unnecessary in units with spring centered gyros.

(a) The current in the RIGHT-DOWN meter should not exceed 4.4 ma for uncentered and 5 ma for centered gyros.

(b) The current in (4) (a) above should not differ from the current found in (3) by more than 0.4 ma for both centered and uncentered gyros.

Pitch Gyro (after being modified to 6°/sec.):

(1) Turn the selector switch to the U-D position.

(2) Adjust the current in each meter to 4 ma.

(a) For *spring gyros,* there should be no indications on the U-D gyro contacts meter, or

(b) For *uncentered gyros,* the U-D gyro contacts meter will indicate either way, depending upon which contacts happen to be closed.

(3) Decrease the current indicated by the LEFT-UP meter until the U-D gyro contacts meter indicates D; then increase the current in the LEFT-UP meter until the U-D gyro contacts meter indicates U 50 percent of the time. The initial reduction of current is unnecessary in units with spring centered gyros. The current in the LEFT-UP meter should not exceed 4.8 ma for uncentered and 4.4 ma for centered gyros.

(4) Return the current in the LEFT-UP meter to 4 ma and decrease the current in the RIGHT-DOWN meter until the U-D gyro contacts meter indicates U; then increase the current in the RIGHT-DOWN meter until the U-D gyro contacts meter indicates D 50 percent of the time. The initial reduction of current is unnecessary in units with spring centered gyros.

(a) The current in the RIGHT-DOWN meter should not exceed 4.8 ma for uncentered and 4.4 ma for centered gyros.

(b) The current in (4) (a) above should not differ from the current found in (3) above by more than 0.3 ma for both types of gyros.

PRECESSIONAL RESPONSE: The precessional response of the gyro units on the gyro panel may be tested by causing the axis of rotation of the gyro wheels to be changed, simulating turn and pitch motions, and observing the response on the LEFT-UP, RIGHT-DOWN, and GYRO CONTACTS meters of the gyro test unit. The gyro wheels of the gyro units must first be brought up to normal operating speed, and the power switch on the gyro test unit must be in the ON POSITION.

Turn and Bias Gyros:

(1) Turn the selector switch to the L-R position.

(2) Adjust the current indicated by each meter to 4 milliamperes.

(a) For *spring centered gyros,* both the L-R and the U-D gyro contacts meters should indicate in their center-scale zero position when the gyro panel is stationary, or

(b) For *uncentered gyros,* the L-R and U-D gyro contacts meters will indicate either way, depending upon which contacts happen to be closed. Since perfect balance is rarely attained, a center-scale position is highly improbable unless both contacts in the gyro are making contact simultaneously.

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(3) Rotate the gyro panel in simulation of a left turn.

(a) The turn gyro should cause the L-R gyro contacts meter to indicate R.

(b) The bias gyro should cause the current in the LEFT-UP meter to increase above 4 ma to approximately 5 ma.

Pitch Gyro:

(1) Turn the selector switch to the D-U position.

(2) Adjust the current indicated by each meter to 4 ma.

(a) For *spring centered gyros*, both the L-R and the U-D gyro contacts meters should indicate in their center-scale zero position when the gyro panel is stationary, or

(b) For *uncentered gyros*, the L-R and U-D gyro contacts meters will indicate either way, depending upon which contacts happen to be closed. Since perfect balance is rarely attained, a center-scale position is highly improbable unless both contacts in the gyro are making contacts simultaneously.

(3) Rotate the gyro panel to simulate raising the nose of the vehicle. The pitch gyro should cause the U-D gyro contacts meter to indicate D.

(4) Rotate the gyro panel to simulate lowering the nose of the vehicle. The pitch gyro should cause the U-D gyro contacts meter to indicate U.

SERVO ARMING:

(1) Turn the selector switch to the SERVO position.

(2) Throw the SERVO ARM toggle switch to ON. The current in the RIGHT-DOWN meter should drop to nearly zero and the current in the LEFT-UP meter should remain unchanged. (Any appreciable reading on the RIGHT-DOWN meter indicates undesirable resistance in the servo arming or ground circuits within the gyro panel.)

(3) Throw the SERVO ARM toggle switch to OFF. The current in the RIGHT-DOWN meter should equal the current in the LEFT-UP meter. (Any difference in meter readings, providing they have been properly calibrated, indicates leakage or a short in the gyro panel wiring or grounds.)

COMBINED GYRO PANEL AND SERVO CHECK:

The gyro panel and the Servo Mk 4 Mod 4 (PU-145/DPN-1) may be checked while interconnected, the gyro panel performing its regular function of controlling the servo unit. To use this method of testing, leave the servo connected to the gyro panel output connector. Attach the gyro test unit to the input connector of the gyro panel, using the cable supplied with the gyro test unit. Operate the gyros by applying suction to the Venturi tube as in the previous checks. Connect the servo to its 14-volt servo battery. Connect the gyro test unit to a 14-volt battery. (It may be connected to the servo battery). Turn the POWER switch of the gyro test unit ON, and adjust the current in the LEFT-UP and the RIGHT-DOWN meters to 4 ma with the selector switch in either the D-U or L-R position. Turn the servo arm switch to ON. The servo motor and dynamotor will start. By manipulating the selector switch and the CURRENT ADJUST controls, the servo will respond by displacing the elevons as below:

POSITION OF SELECTOR SWITCH	METER WITH HIGHER CURRENT	ELEVON DISPLACEMENT	
		RIGHT	LEFT
D-U	LEFT-UP	Down	Down
D-U	RIGHT-DOWN	Up	Up
L-R	LEFT-UP	Down	Up
L-R	RIGHT-DOWN	Up	Down

There will be no indication on the gyro contacts meters when using this test procedure, the displacement of the elevons serving as the indicators instead.

This combined check will not be very satisfactory with gyro panels employing *uncentered gyros*, since there will be no control of the centering and contacting of one gyro while the other is being checked, resulting in much uncontrolled servo action and elevon movement in the channel not being checked.

Figure 55 shows the interconnections between the Gyro Panel Mk 6 Mod 1 (CN-75/DPN-1) and the Servo Mk 4 Mod 4 (PU-145/DPN-1).

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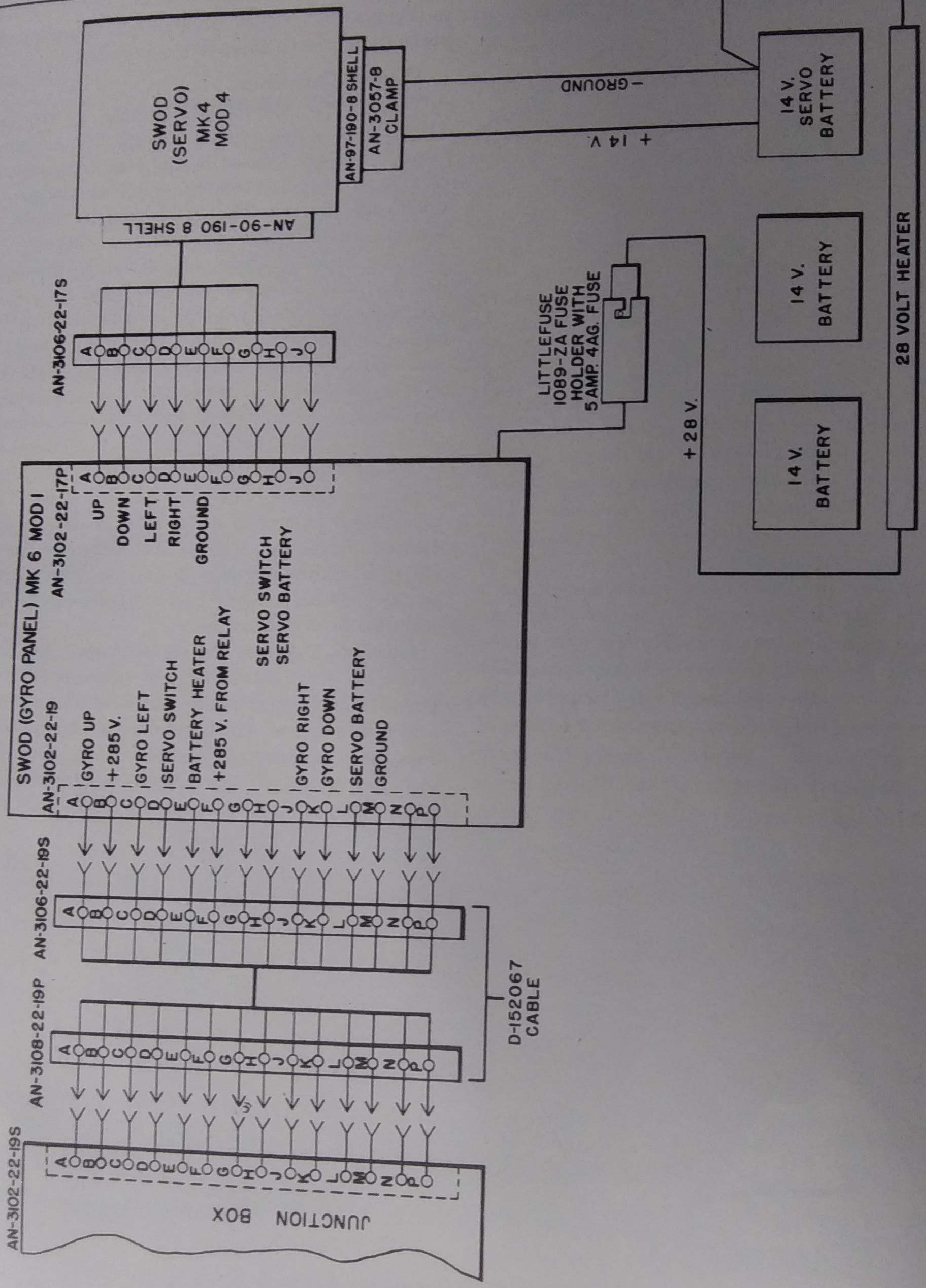

Figure 55—Interconnecting Diagram for Gyro Panel Mk 6 Mod 1 and Servo Mk 4 Mod 4.

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8. SWOD (SERVO) MARK 4 MOD 4

a. General Description

The SWOD (Servo) Mark 4 Mod 4 (Flight Control Servo PU-145/DPN-1) shown in Figure 56 is a combination electrical and mechanical device which supplies the mechanical power and proper motion for the flight control motions of the control surfaces of the SWOD (Air Stabilizer) Mk 13 Mod 0, in response to intelligence signals from the SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN-73/DPN-1). It is placed in operation at the instant that the air stabilizer is released for flight, operating on gyro control only. After 3-second delay, correction begins through the reception of radar signals. The electrical portion consists of four solenoids which cause gears to be engaged in response to signals from the gyro panel, and a dynamotor which supplies the electrical potential for the operation of the solenoids. The mechanical portion consists of an electric motor which runs continuously when the servo is in operation, and two mechanical gear channels, each of which may be operated in either direction. This gear action is applied through two screw-shaft reduction units to a servo linkage assembly which converts the rotation of the screw-shafts into the proper longitudinal motion of a pair of elevon control rods. Figure 57 shows the servo with its protective covers removed. Relays which are used for activating the tail elevators are shown in Figure 58. Other photographs showing the servo do not have these relays installed.

b. Detailed Description

The SWOD (Servo) Mk 4 Mod 4 (PU-145/DPN-1) is self-contained, except for a 14-volt storage battery located in the rear compartment of the air stabilizer and required as a source of operating power. The servo weighs about 37 pounds with cables but without battery. It features rapid response, is positive in operation, and has a minimum of electrical and mechanical adjustments. It is capable of withstanding considerable shock and abuse, long periods of storage and transportation under unfavorable conditions of temperature and moisture, and exposure to corrosive agents, dust and sand. It operates most efficiently at low temperatures. It delivers approximately 1,500 inch-pounds maximum torque with the motor operating at 12 volts. The mechanical process is irreversible, so that a force exerted on the servo arms will not react to run the gear train. Figures 59 and 60 show various parts of the servo while Figure 61 shows the servo installed in the air stabilizer.

Control Circuit: The servo components which cause the servo-mechanism to respond to intelligence from the gyro panel consist of four solenoids and a dynamotor which supplies a high potential for their operation, together with four limit switches to prevent servo action outside the limits of safe flight conditions and the mechanical limits

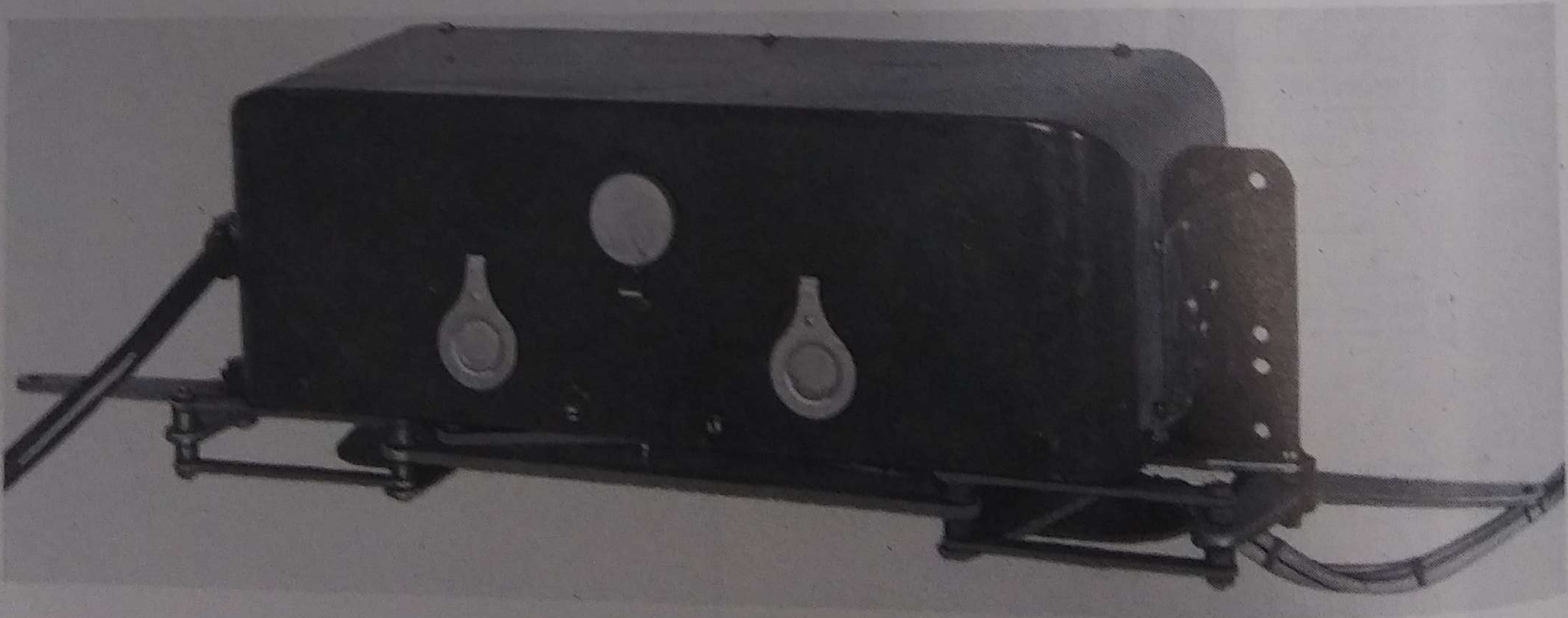

Figure 56—SWOD (Servo) Mk 4 Mod 4.

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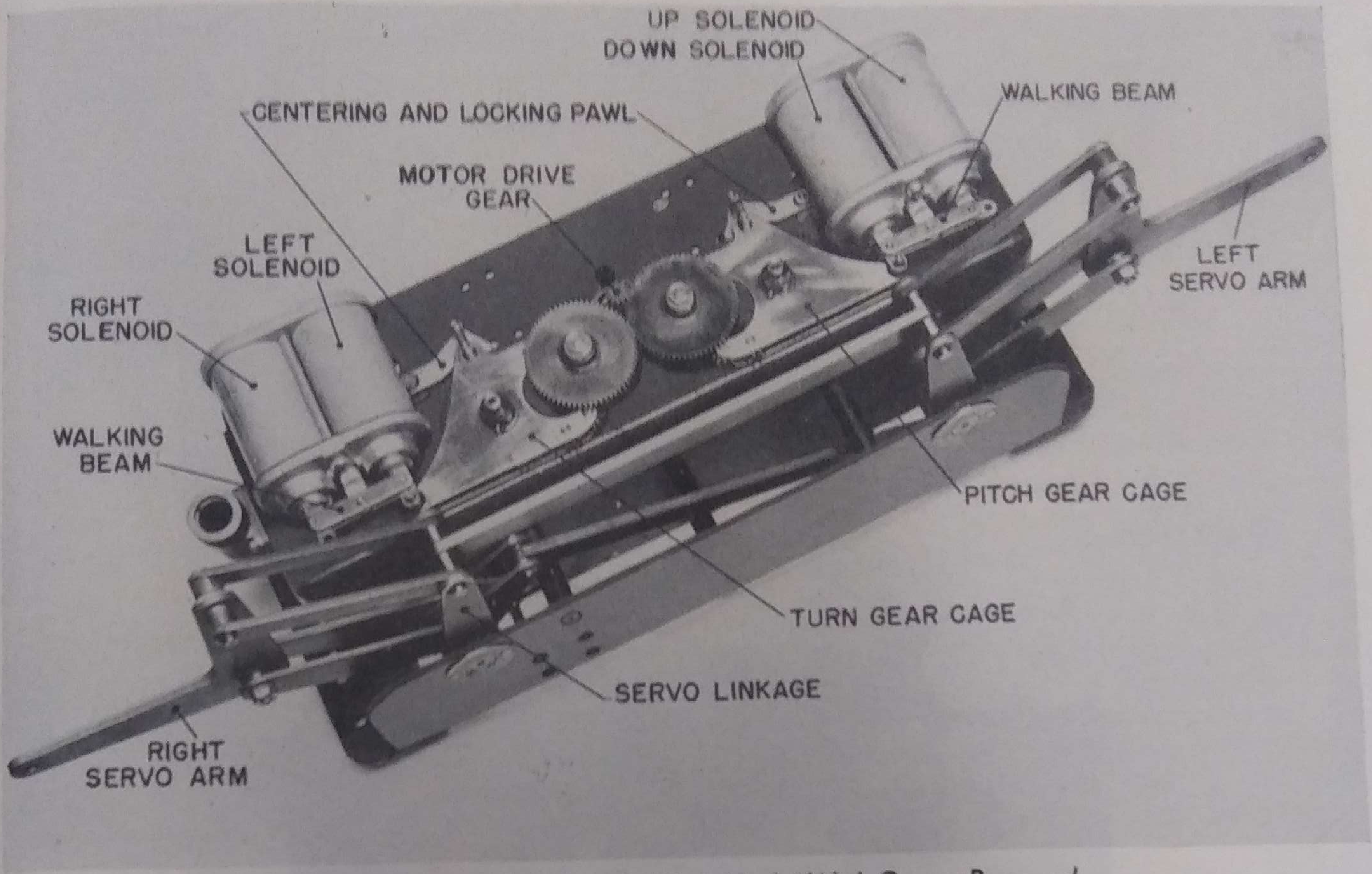

Figure 57—SWOD (Servo) Mk 4 Mod 4 With Covers Removed.

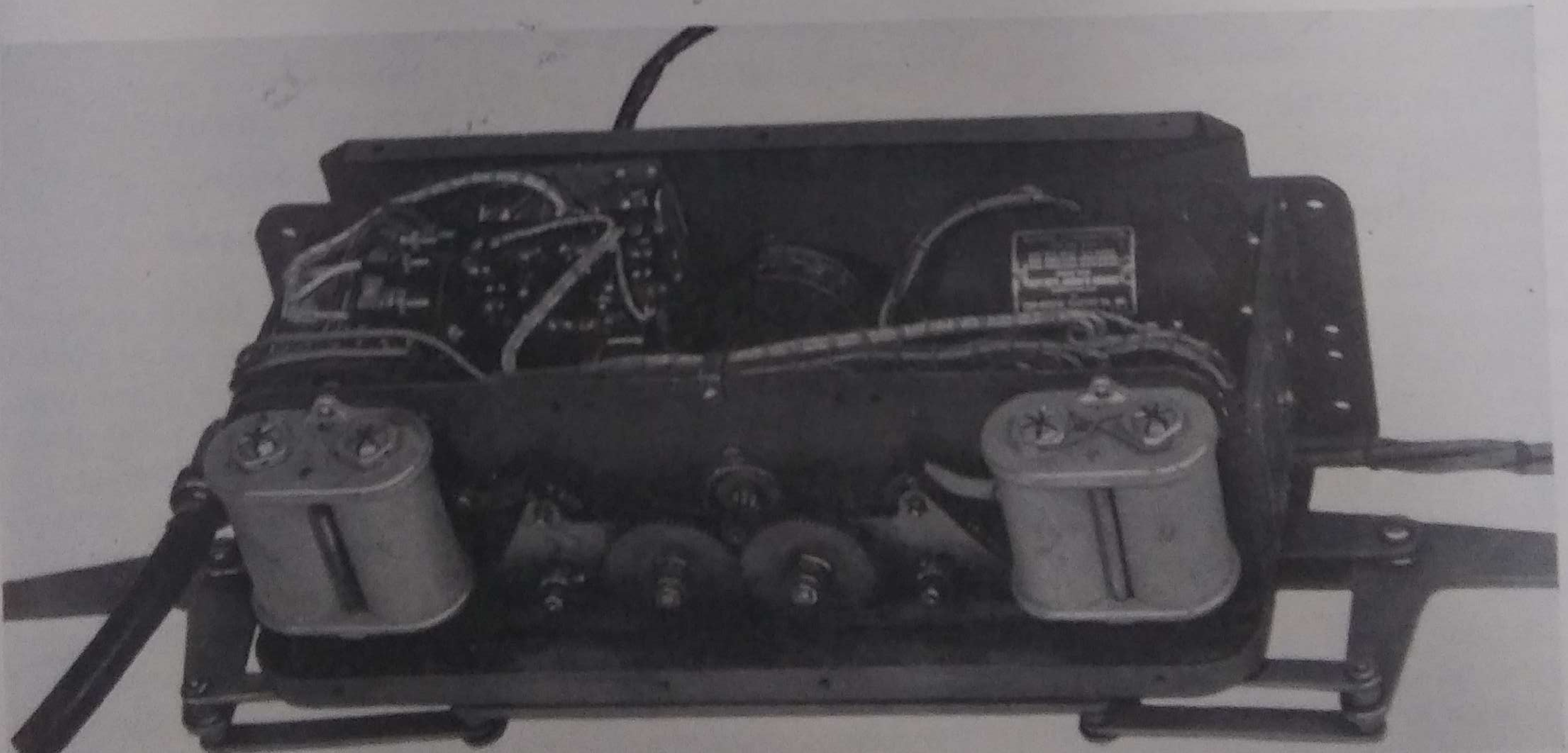

Figure 58—SWOD (Servo) Mk 4 Mod 4 Showing Tail Elevator Relays.

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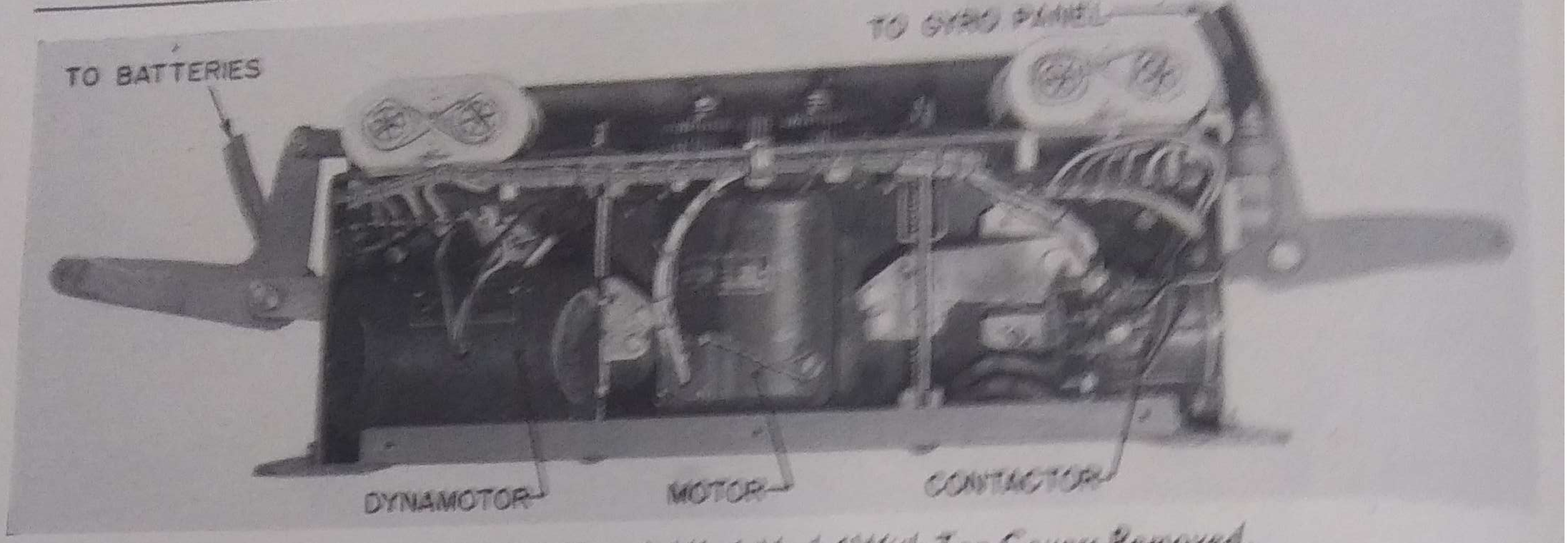

Figure 59—SWOD (Servo) Mk 4 Mod 4 With Top Covers Removed.

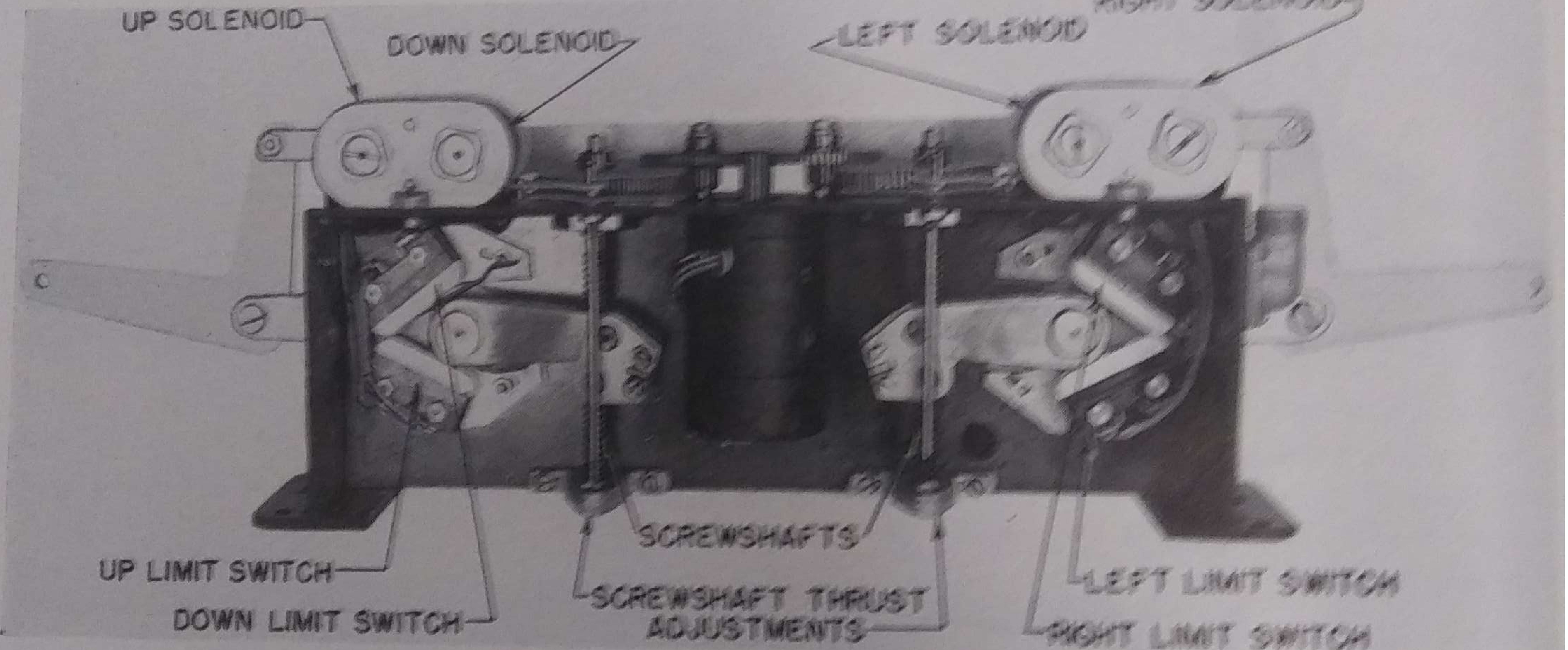

Figure 60—SWOD (Servo) Mk 4 Mod 4 With Covers and Electrical Equipment Removed.

of operation. A schematic of this portion of the servo wiring is shown in Figure 62.

The closing of a contact in either the pitch or turn gyro will allow current to flow through one of the solenoids, causing the plunger to be pulled into the coil and thus rotate the walking beam attached to it. This walking beam is linked to a gear cage which will be rotated when the beam moves.

A limit switch is connected in each solenoid circuit to open the circuit when the limit of safe operation in the direction governed by that solenoid is reached. The switch is adjusted by bending the switch arm or rotating the mounting plate.

Each solenoid coil consists of 14,000 turns of No. 35 enameled copper wire wound on a molde plastic spool and covered with fiber glass tap The coil resistance is approximately 1,200 ohms, and the normal operating current is 100 to 13 milliamperes. The coils are tested at 120-vol input, in which case, the current should be betwee 90 and 100 milliamperes.

The solenoid case, core, lockout, and plunge are made of cadmium-plated ingot iron. Th walking beam and link are made of stainless stee with monel rivets and sleeves. The plunger guide, pin, guide ring, and 0.005-inch-thick cone bottoming washer are made of phosphor bronze. Thes

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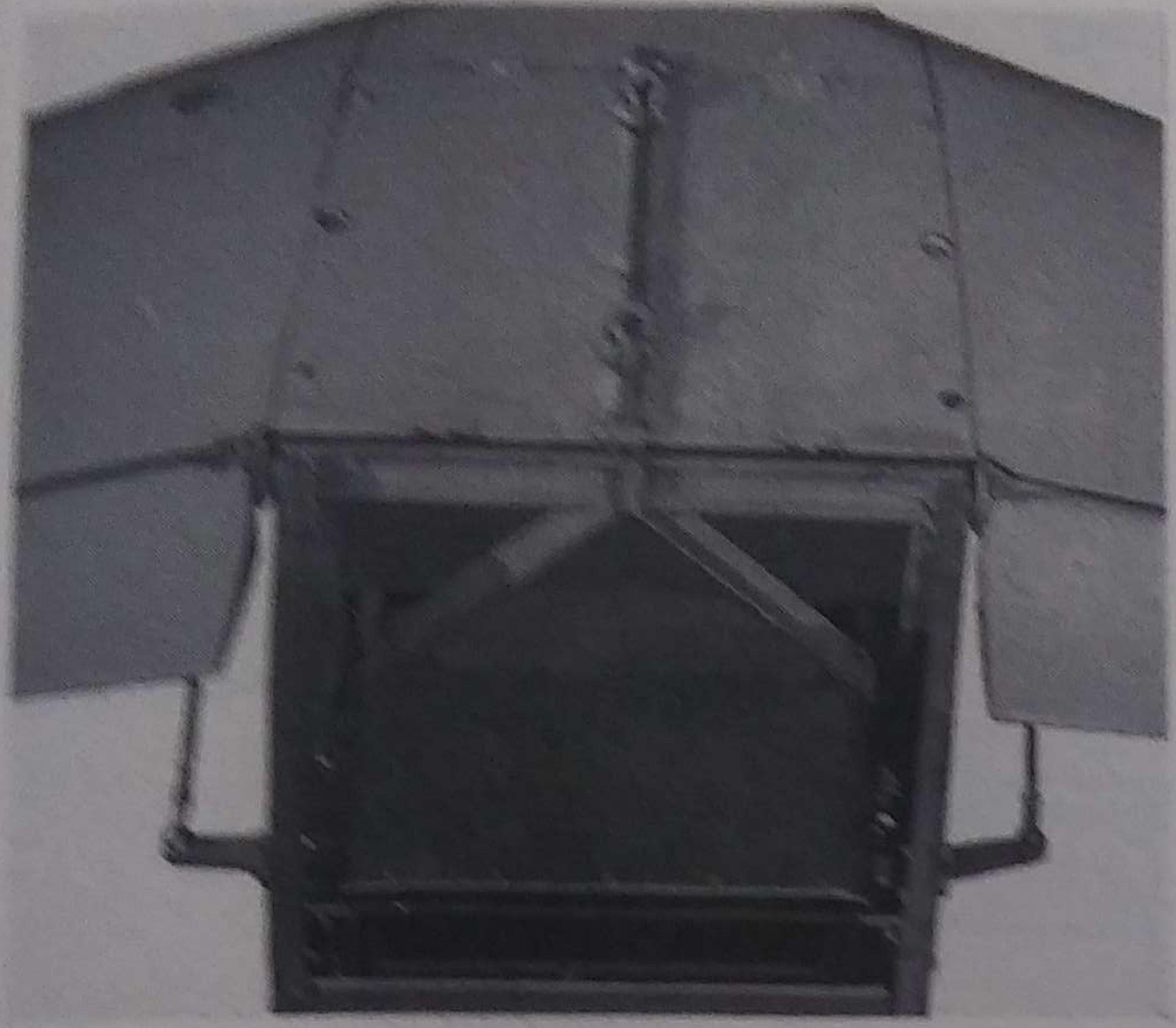

Figure 61—SWOD (Servo) Mk 4 Mod 4 Installed in SWOD (Air Stabilizer) Mk 13 Mod 0.

guides and bottoming washer prevent magnetic contact of the plunger with the case and core. On later models, a castel-type locknut of cold-rolled steel is used. For these nuts the cores are drilled for safety wiring rather than slotted as when used with the flat-type locknuts. Figure 63 shows details of this assembly.

When the solenoid is energized, the position of the plunger is adjusted by means of threads and a locknut on the top end of the core. Adjustment of the plunger position governs the meshing of the clutch gears and greatly influences the power output of the servo. An adjustment that is too tight will decrease the power, and an adjustment that is very loose may cause the gear clutch to disengage under load.

The type DMX-310 dynamotor is used. It is rated for continuous service at 12 volts, 2.8 amperes d-c input, and 150 volts, 100 milliamperes d-c output. For intermittent service (not to exceed 5 minutes at a time) it may be operated at 12 volts, 4.4 amperes d-c output and 125 volts, 200 milliamperes d-c output. When operated from a 14-volt battery, it will deliver about 175 volts d-c at 135 milliamperes.

The dynamotor has ball bearings which are life-time lubricated with RCX-148 low-temperature grease No. 67, or with Beacon M285 grease.

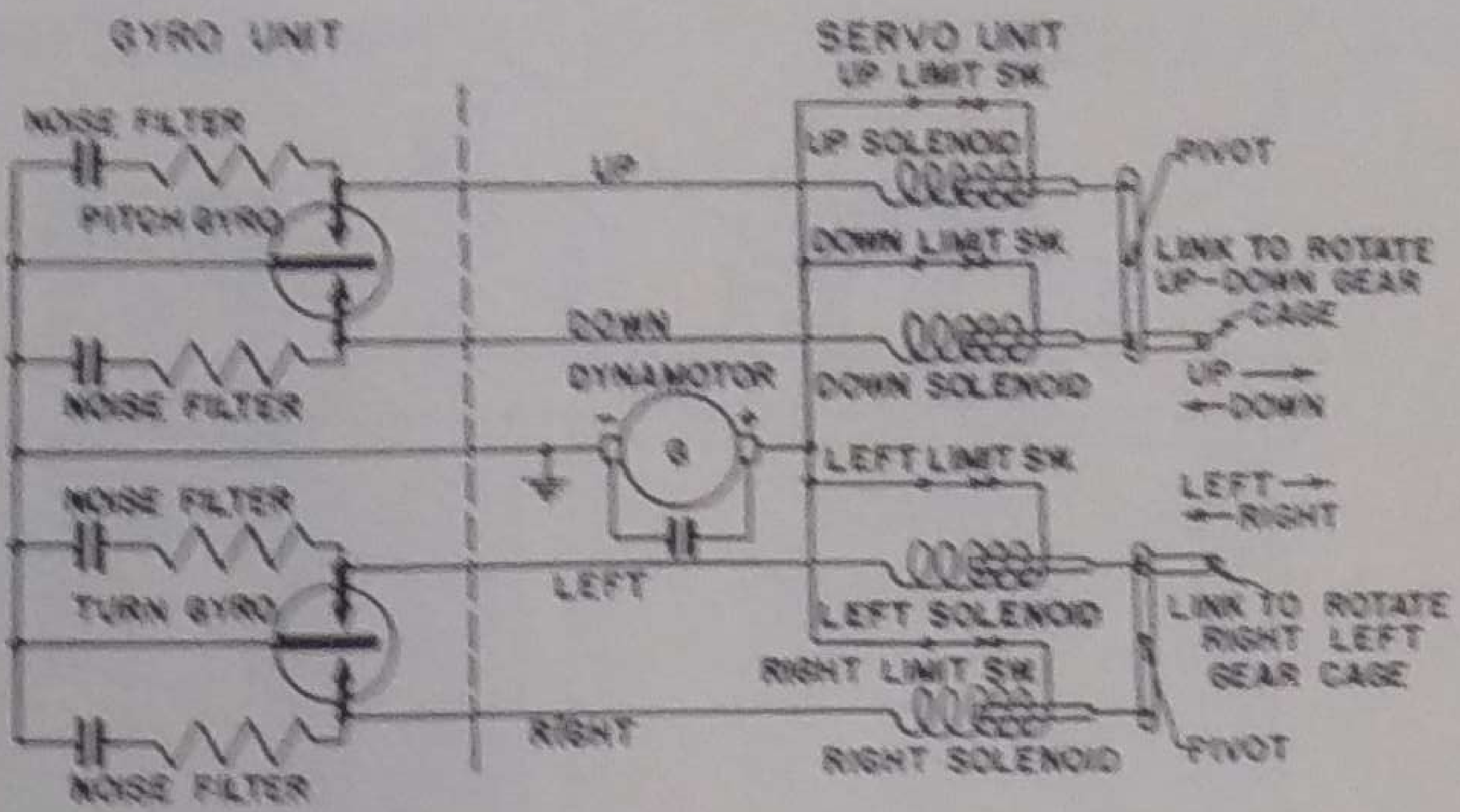

Figure 62—Servo Control Circuit Schematic.

The negative brush holders of both the input and output sides of the dynamotor are of all-metal construction and are grounded internally to the bearing bracket casting and externally by a ground lead to the dynamotor mounting as an aid to interference suppression. This externally grounded negative lead is black, the positive low-voltage lead is white, and the positive high-voltage lead is red. A 0.01-mfd paper capacitor is connected across the low-voltage input; and a 0.003-mfd or a 0.006-mfd mica capacitor, which must be rated at 600 volts working and must have passed a 1,000-volt flash test, is connected across the high-voltage output.

Motor Circuit: SWOD (Servo) Mk 4 Mod 4 (PU-145/DPN-1) uses a ⅙ h-p 12-volt compound d-c motor. This motor is totally enclosed and of aircraft-type construction. It is rated to operate at 3,800 r. p. m. in a clockwise direction when viewed from the shaft end. The ball bearings are permanently lubricated with low temperature grease. A 0.02-mfd bypass capacitor is connected internally from brush to brush; and the negative brush is grounded at the holder. The no-load current of the motor at 12 volts input should not exceed 6 amperes while operating only the gearing and linkages. An electrical schematic of the SWOD (Servo) Mk 4 Mod 4 is shown in Figure 64. The standard aircraft-type contactor which energizes the motor and dynamotor requires 14 volts for operation. Earlier units employ a Cutler Hammer BUL-6041H50A contactor with a 16-ohm coil and two sets of contacts rated at 50 amperes each. Later units employ the Cutler Hammer BUL-6041H158 contactor with a 26-ohm coil and a single set of contacts rated at 50 amperes. The contactor coil is energized when the arming

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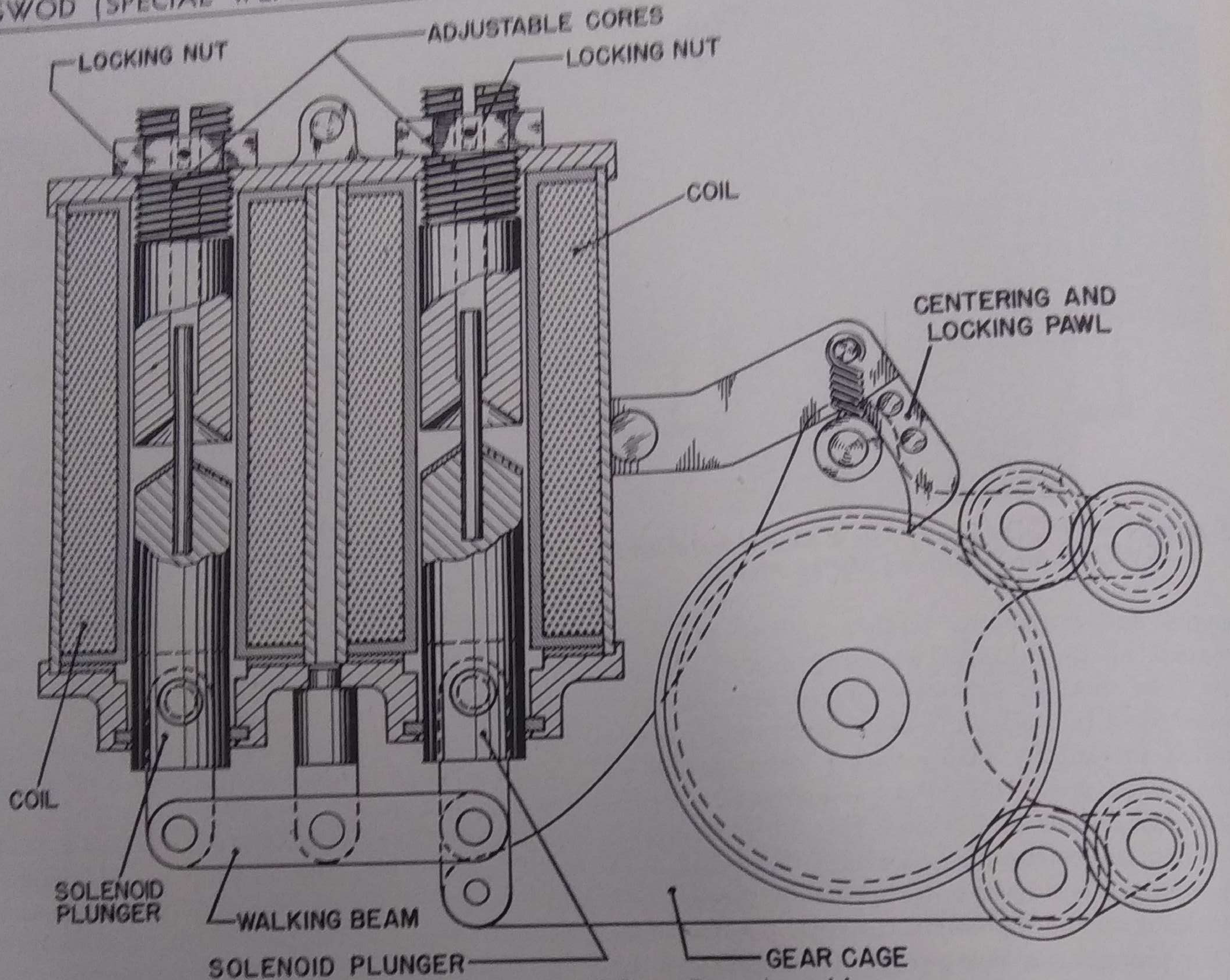

Figure 63—Solenoid and Gear Cage Assembly.

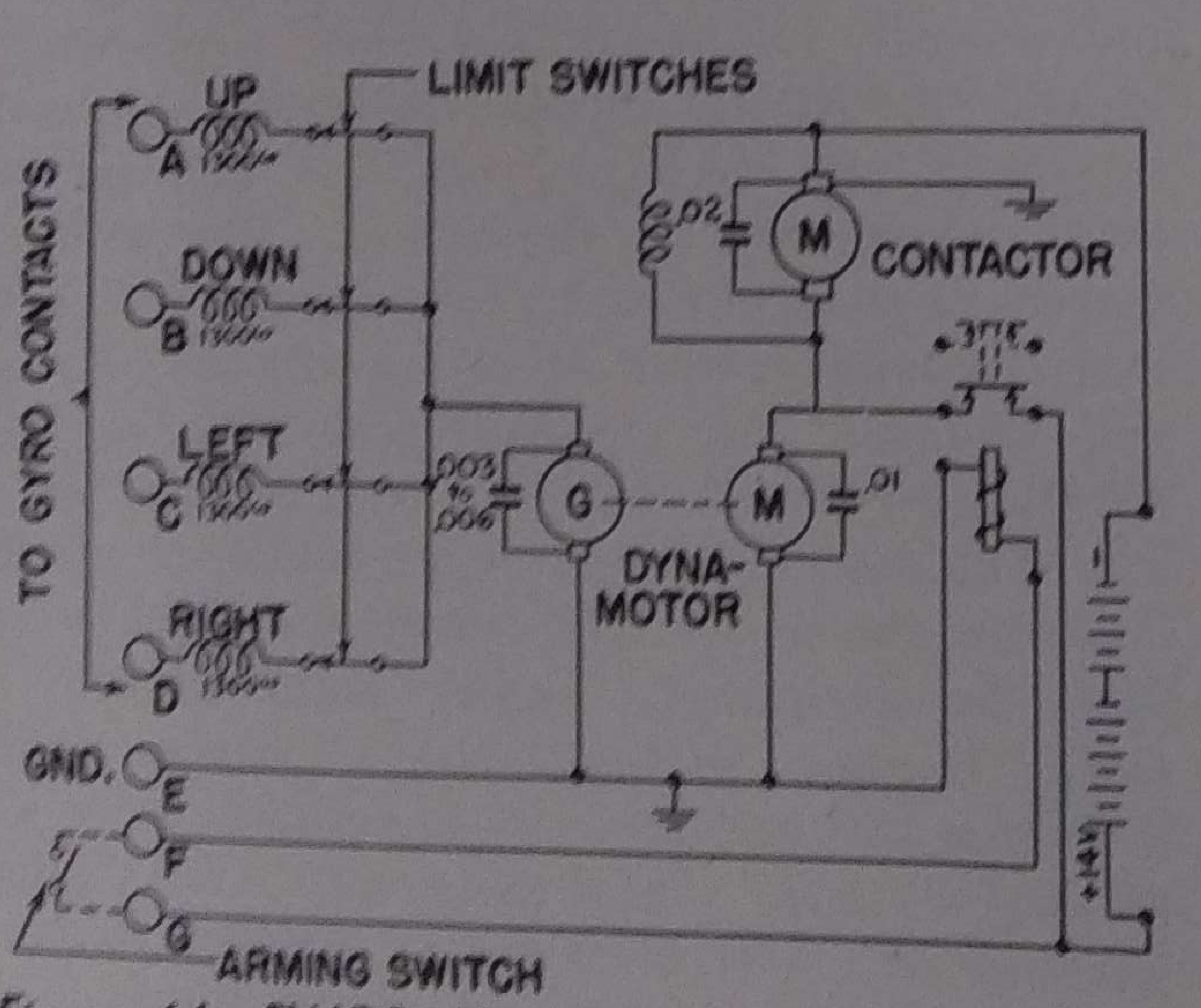

Figure 64—SWOD (Servo) Mk 4 Mod 4 Electrical Schematic.

pin on the junction box is pulled, releasing the timing switch mechanism. When the contactor closes, a 14-volt potential is applied to the motor and the dynamotor. Thus these two units operate continuously from the instant the arming pin is pulled. Refer to Figures 130, 131, and 132 for details of Servo Mk 4 Mod 4 wiring.

Gear Train and Clutch: The name "gear clutch" is derived from the action of small gears being meshed into the gear train by the pull of the solenoid rotating the gear cage in which they are mounted. This action is essentially a clutching action, since it connects the motor power to the servo linkage.

The motor supplying the power to operate the servo rotates continuously at a speed of about

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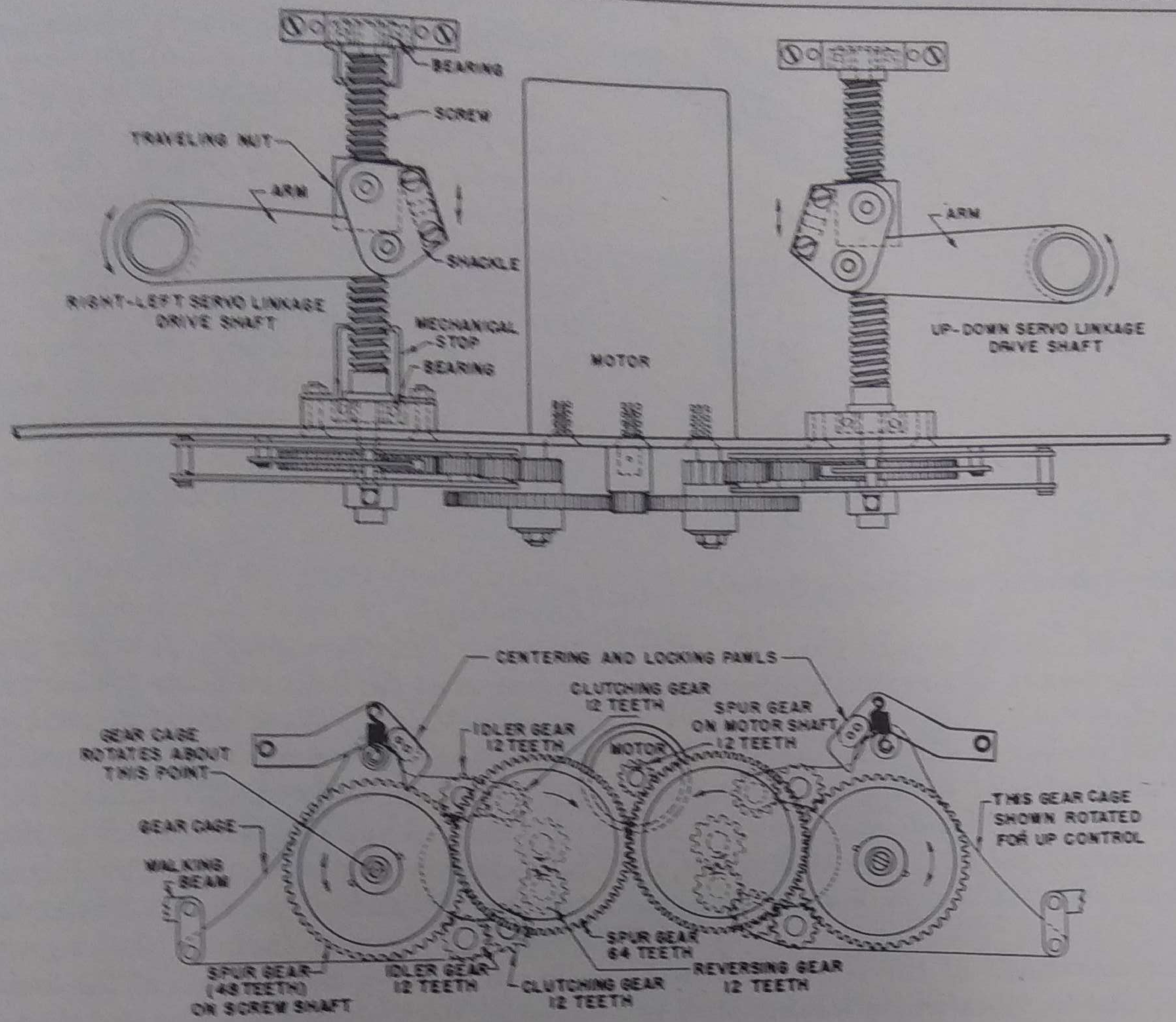
BEARING
SCREW
TRAVELING NUT
ARM
SHACKLE
RIGHT-LEFT SERVO LINKAGE DRIVE SHAFT
MECHANICAL STOP
BEARING
MOTOR
ARM
UP-DOWN SERVO LINKAGE DRIVE SHAFT
CENTERING AND LOCKING PAWLS
CLUTCHING GEAR 12 TEETH
SPUR GEAR ON MOTOR SHAFT 12 TEETH
IDLER GEAR 12 TEETH
MOTOR
GEAR CAGE ROTATES ABOUT THIS POINT
GEAR CAGE
WALKING BEAM
THIS GEAR CAGE SHOWN ROTATED FOR UP CONTROL
SPUR GEAR 64 TEETH
SPUR GEAR (48 TEETH) ON SCREW SHAFT
IDLER GEAR 12 TEETH
CLUTCHING GEAR 12 TEETH
REVERSING GEAR 12 TEETH

Figure 65—SWOD (Servo) Mk 4 Mod 4 Gear Clutch Arrangement.

3,800 r. p. m. in a clockwise direction when viewed from the shaft end (Figure 65). The 12-tooth spur gear on the motor shaft operates two large 64-tooth spur gears which turn continuously in opposite directions. One of these large gears operates the up-down servo action, the other the right-left action. Each of these large gears has a 12-tooth reversing spur gear. The gear reduction to this point is 64 to 12.

When a solenoid is energized, its walking beam rotates the gear cage and a 12-tooth clutching gear is pulled into mesh with one of the continuously rotating 12-tooth gears (Figure 65). This small gear transmits the motion through a second 12-tooth idler gear to a 48-tooth gear mounted on the screw shaft. Energizing the other solenoid of the same channel would rotate the gear cage in the opposite direction, causing the clutching action to take place with the other continuously operating 12-tooth gear rotating in the opposite direction. The screw shaft would then be rotated in the opposite direction. The gear reduction in this action is 48 to 12, making the total reduction from the motor to the screw shaft 64 to 3.

On each of the stainless steel screw shafts is a phosphor bronze traveling nut and shackle (Figure 66). As one of the screws is rotated by the appropriate gear clutch train, the travel of the nut is transmitted by the shackle to a 2$\frac{3}{16}$-inch arm which rotates one of the servo linkage drive shafts. This screw, nut, shackle, and arm assembly provides an additional reduction ratio of approximately 125 to 1. The axes of the servo drive shafts are perpendicular to the axis of the motor shaft.

The gears are made of nitrided stainless steel

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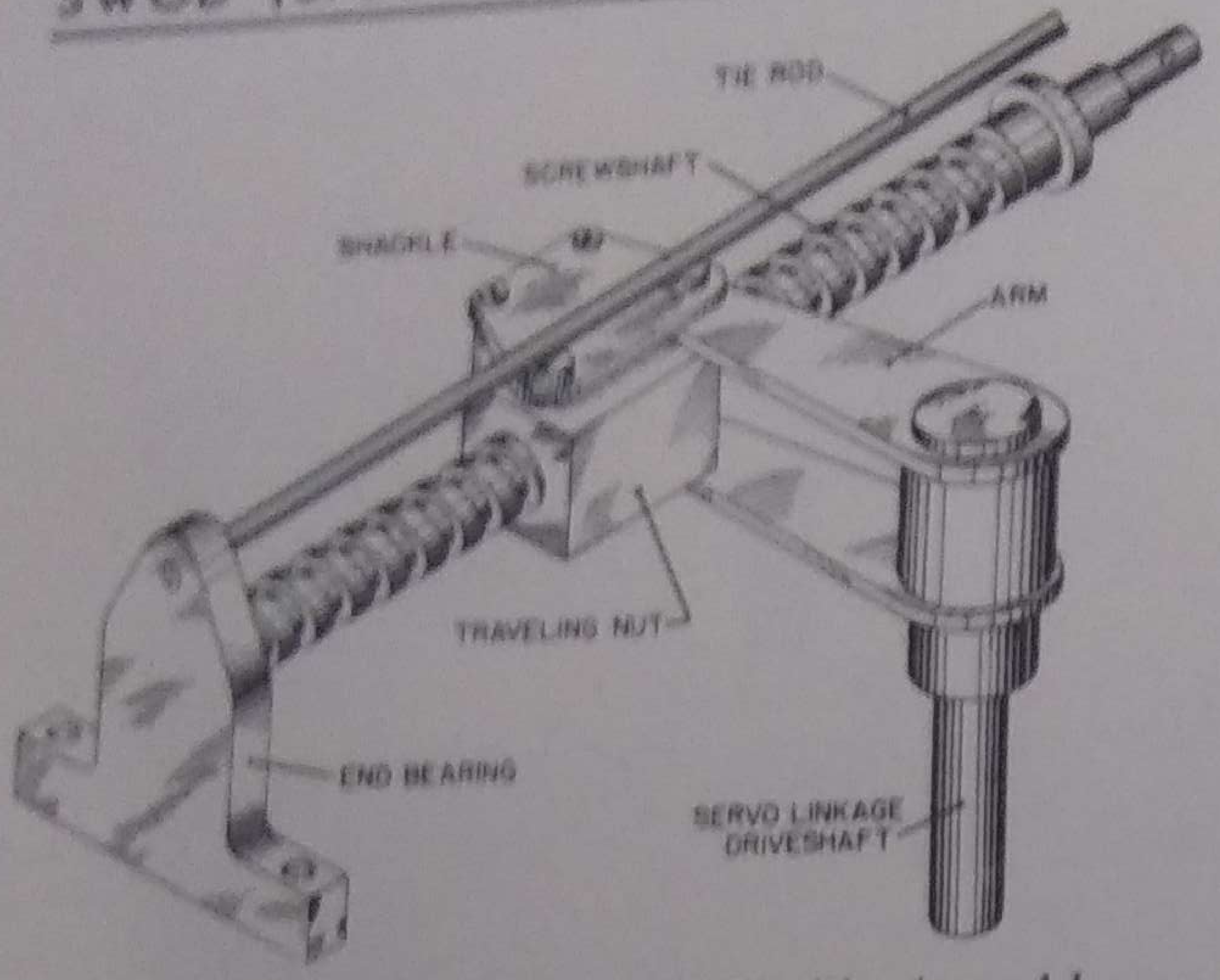

Figure 66—Screwshaft and Shackle Assembly.

mounted on "KR" monel metal axles. The gear cages, centering pawls, and centering springs are made of stainless steel.

The stainless steel screw shafts are supported by a shielded ball bearing at each end, permanently lubricated with Beacon M-285 grease suitable for a wide temperature range. The screw itself is lubricated with Alemite No. 29 low-temperature oil.

To prevent movement of the screw shaft and traveling nut due to vibration, a locking pawl is attached to each gear cage centering pawl, as shown in Figures 63 and 65. When the gear cage is in its centered position, this locking pawl is brought into mesh with the teeth of the 48-tooth gear on the screw shaft by the action of the centering spring with sufficient force so that the action of vibration alone will not be sufficient to cause the pawl to ratchet and allow the gear to turn. Rotation in either direction due to vibration is thus prevented at all times when the gear cage is not rotated by the action of the solenoids. When either gear cage is rotated, the cam action of the centering pawl withdraws the locking pawl from the corresponding 48-tooth gear and permits rotation of this gear in either direction by the motor.

Limit switches are provided on each side of each 2$\frac{3}{16}$-inch arm to open the control circuit for the particular solenoid involved when the elevons have reached the limiting position consistent with safe flight, and before the traveling nut has reached the safety region at the end of the screw.

A key is provided which fits through protected holes in the front cover of the servo unit onto the ends of the screw shafts. By this means the screw shafts may be turned manually to adjust the servo linkage to any desired position for pre-flight adjustment. Sufficient force can be exerted by the key on the screw shaft and its associated gears to cause the locking pawl to ratchet, allowing the screw shaft to be rotated in either direction. A holder is provided in the front cover for this key when it is not in use; and a spring clip prevents the key from being unscrewed from its holder by vibration.

Mechanical stops are placed on the right-left screw shafts to make it impossible to key the traveling nut far enough past the position of operation of the limit switches to change the limit switch settings. These stops are not required on the dive and glide screw shaft since practically the full run of the screw shaft is utilized in the dive-glide channel and the limit switch settings cannot be endangered by keying the traveling nut to the mechanical limits of the run. A safety margin of approximately one turn of the screw shaft is allowed between the position of the traveling nut at which the limit switch opens and the mechanical stop on the right-left screw shaft of the mounting bearing on the dive-glide screw shaft.

The neutral position of each servo is determined at the factory and is indicated by lines scribed on the right-left and dive-glide drive shafts and their respective bushings. When the unit is in neutral, the lines on the drive shafts and bushings are in alignment, as shown in Figure 67.

Each servo is shipped set in the neutral position, and should remain in neutral because of the action of the locking pawls. The servo may be reset to neutral at any time by keying the two screw shafts, using the key provided with each unit, so that both scribed lines are in alignment. The spring action of the locking pawls prevents creeping of the gears due to vibration but permits keying of the screw shafts.

In the design and manufacture of this equipment efforts have been made to keep backlash to a minimum. The maximum permissible no-load

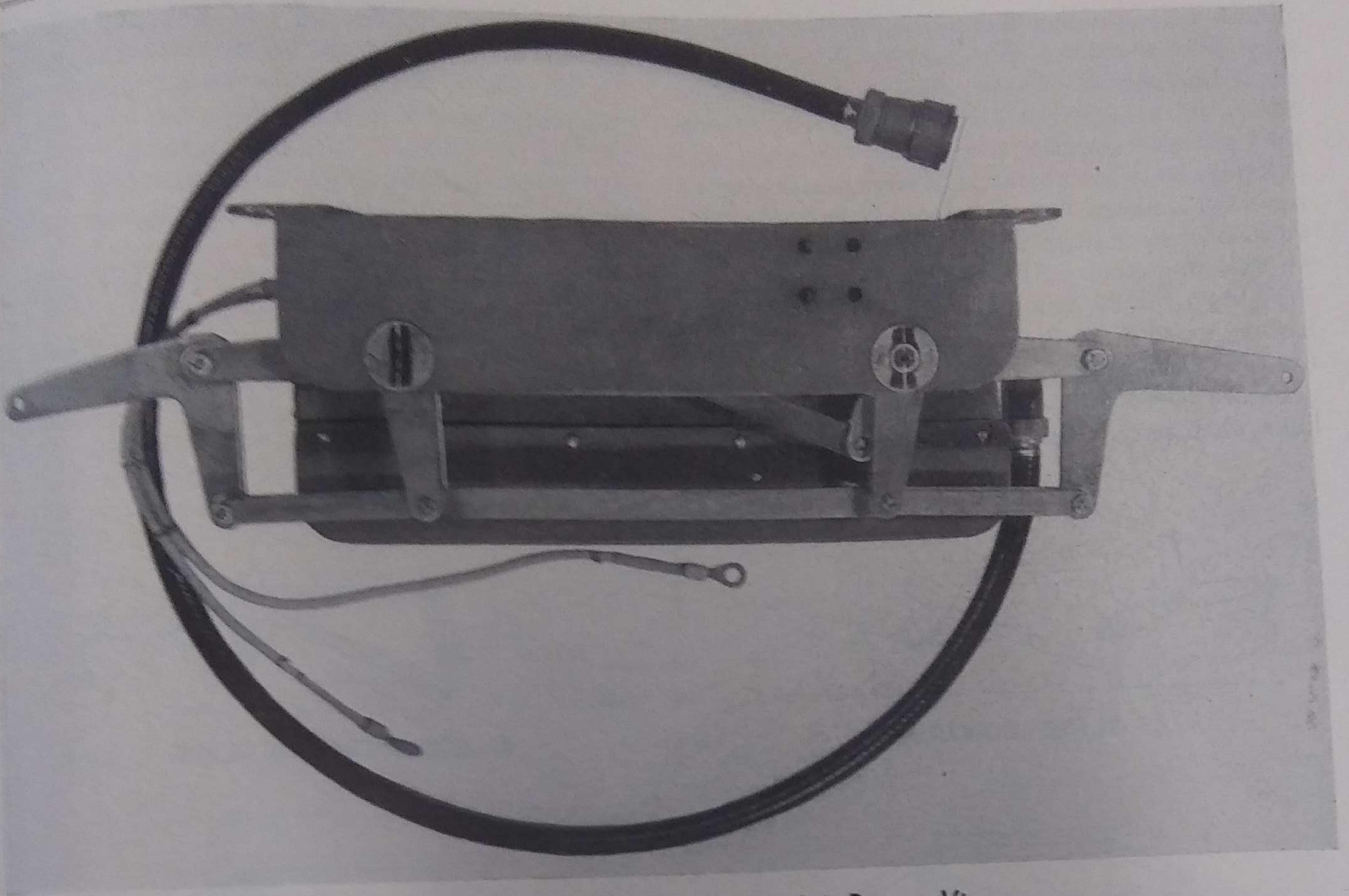

Figure 67—SWOD (Servo) Mk 4 Mod 4, Bottom View.

backlash in terms of movement at the ends of the servo arms, is 0.04 inch.

SERVO LINKAGE: The servo linkage is made of stainless steel links fastened together with monel metal pins. It translates the rotation of either or both servo linkage driveshafts, clockwise and counterclockwise, into a longitudinal movement of the elevon control rods. To accomplish this, the ends of the linkage arms to which the control rods attach move in approximately pure translation. For dive-glide control, the control rods are both moved fore or both aft simultaneously the same amount and at the same rate. For right-left control, the control rods are moved differentially, one fore and the other aft simultaneously the same amount and at the same rate. The linkage also responds to dive-glide and right-left controls simultaneously, such as right and glide or left and dive, the movement supplied to the elevon control rods being the sum of the component movements.

To study the operation of this linkage, the movements of the parts associated with the dive-glide control and the right-left control may be analyzed separately. The driveshafts, one (a) driving the dive-glide movement (in response to signals from the pitch gyro) and the other (b) the right-left movement (in response to signals from the turn gyro), form the two fixed points of rotation, and the servo chassis on which they are mounted forms the fixed element in the mechanism.

In Figure 68-A can be seen an angle member

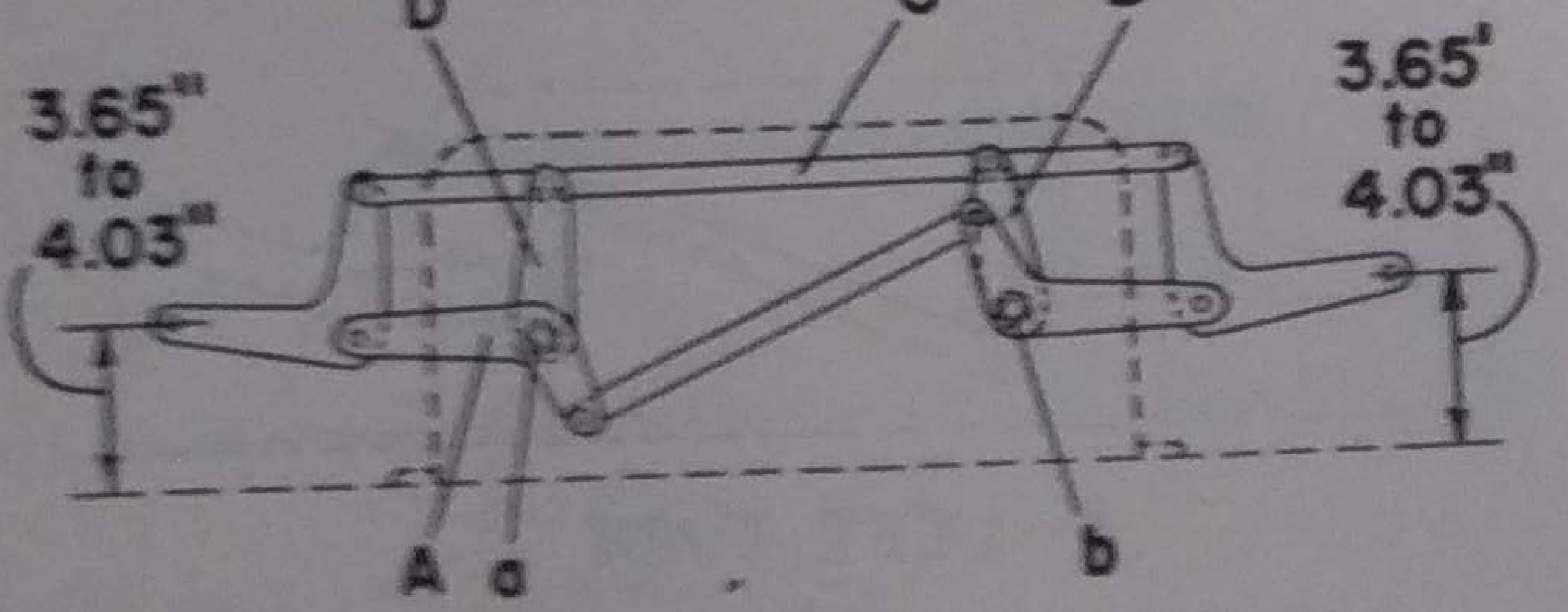

Figure 68—Servo Linkage Neutral Position.

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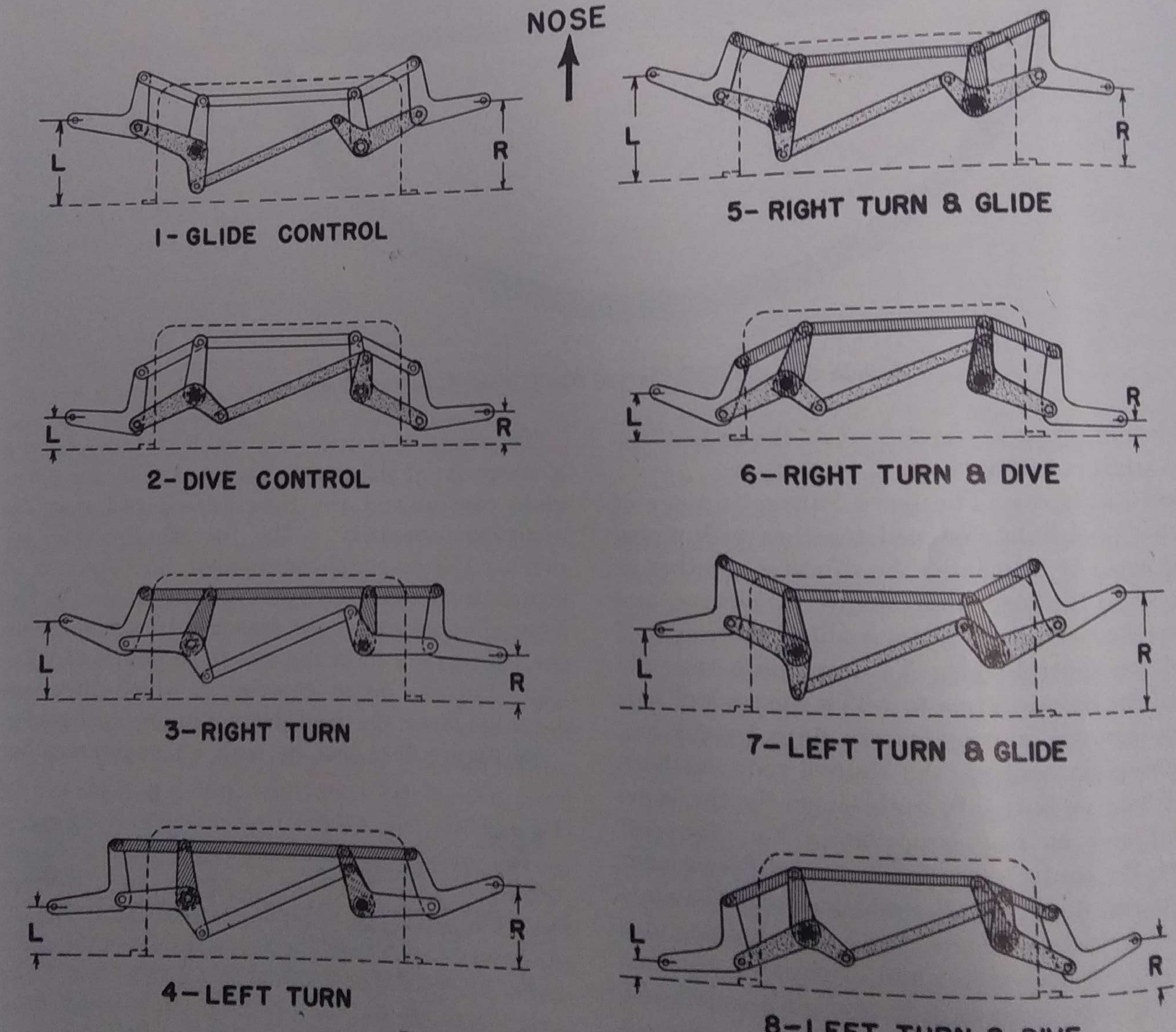
pinned with stainless steel taper pins to the dive-glide driveshaft (a) that powers the dive-glide control movement. Part B shows a beam or lever pinned to the right-left driveshaft (b) that powers the right-left control movement.

Figure 69 shows the approximate positioning of the servo linkage for elevon displacement in the various control positions. These figures are applicable to a servo unit oriented as in SWOD (Air Stabilizer) Mk 13 Mod 0. In all cases the view is looking down upon the unit with the nose toward the top of the page.

Figure 69—1 shows the position of the various links when part A has been rotated clockwise by the dive-glide driveshaft. In this position the elevons are pushed down by the forward motion of the tie rods to the maximum "glide" control. For this motion part B does not move, but it holds connecting rod C and D in a fixed position. The left and right parallelogram links therefore are as shown, giving forward translated motion to the elevon control rods.

In a "Dive" control, Figure 69—2 the opposite motion takes place.

The right and left control movements shown in Figures 69—3 and 69—4 are accomplished by the rotation of beam B clockwise and counterclockwise, respectively. For right turn, the right tie rod



1-GLIDE CONTROL

2-DIVE CONTROL

3-RIGHT TURN

4-LEFT TURN

5-RIGHT TURN & GLIDE

6-RIGHT TURN & DIVE

7-LEFT TURN & GLIDE

8-LEFT TURN & DIVE

Figure 69—Servo Link ions.

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is pulled back and the left is pushed forward. The left turn is accomplished by the reverse action. Combination control movements are shown in Figure 69—5, 6, 7, and 8. To accomplish both control functions simultaneously the right-left movement is added to the dive-glide movement in each case.

c. Installation

SWOD (Servo) Mk 4 Mod 4 (PU–145/DPN–1) is installed in the fuselage of the Mod 0 air stabilizer in a location abaft the wings, as shown in Figure 61. The servo arms project through slots in the fuselage allowing the connection of the straight adjustable elevon control rods.

The servo is secured to both sides of the fuselage by a pair of steel mounting brackets. Steel bolts with elastic stop nuts attach the servo to the mounting brackets and the brackets to the fuselage, Figure 70.

d. Adjustment and Testing

The SWOD (Servo) Mk 4 Mod 4 (PU–145/DPN–1) has three types of adjustments, the positioning of the solenoid cores to given proper meshing of the clutch gears, the adjustment of the limit switches to keep the travel of the servo arms within predetermined limits, and the adjustment of the end-play or thrust of the screw shafts. These adjustments are made at the factory or assembly plant and should therefore be correct if the unit passes a simple check-out, provided that the unit otherwise has not been subjected to abnormal conditions and is known to have been adjusted for the particular application for which it is being used.

To make the check-out of a servo unit, a servo control box which connects to the cable connector of the servo is employed to control the servo in lieu of the gyro system and arming switch. A

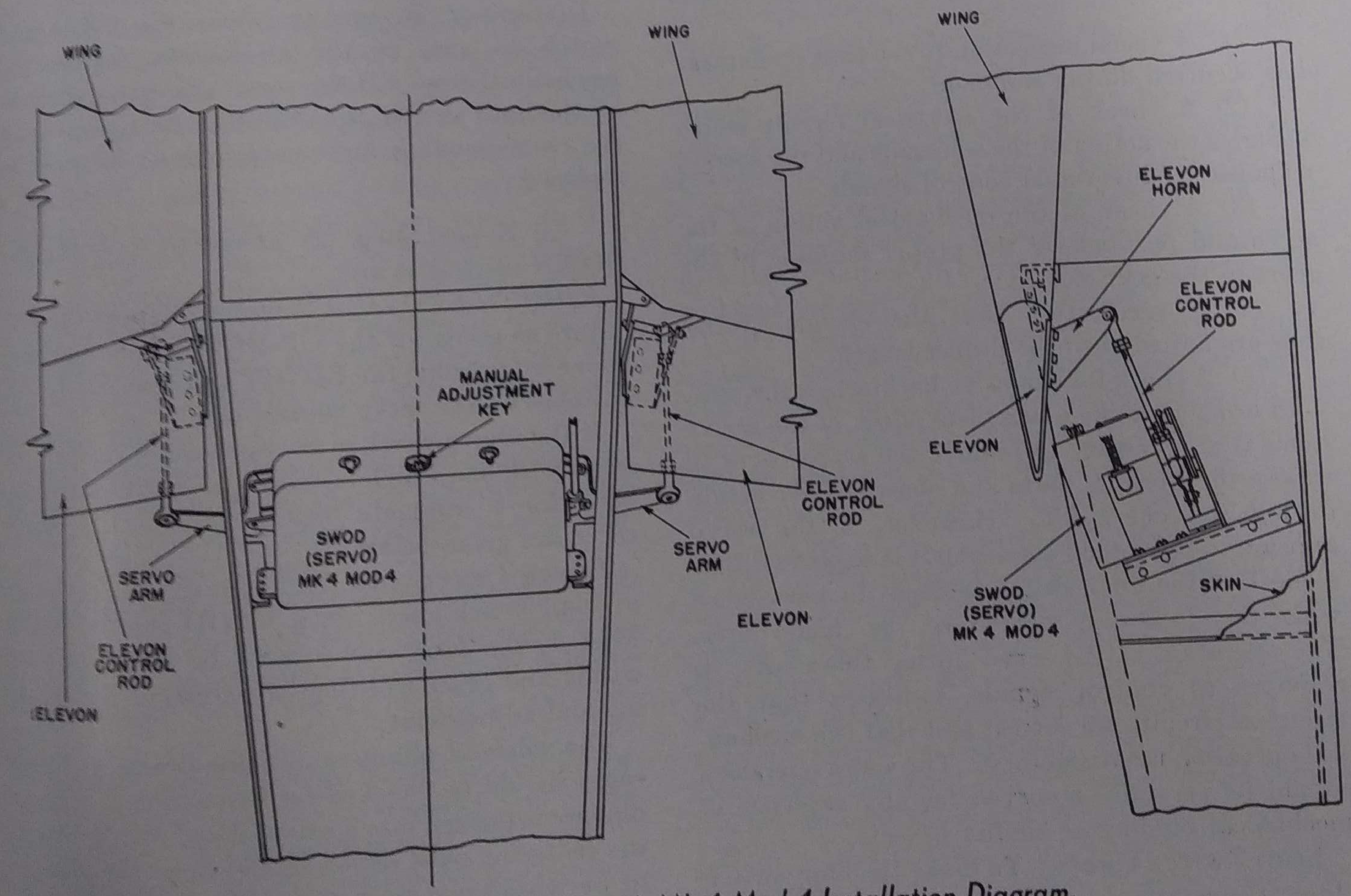

Figure 70—SWOD (Servo) Mk 4 Mod 4 Installation Diagram.

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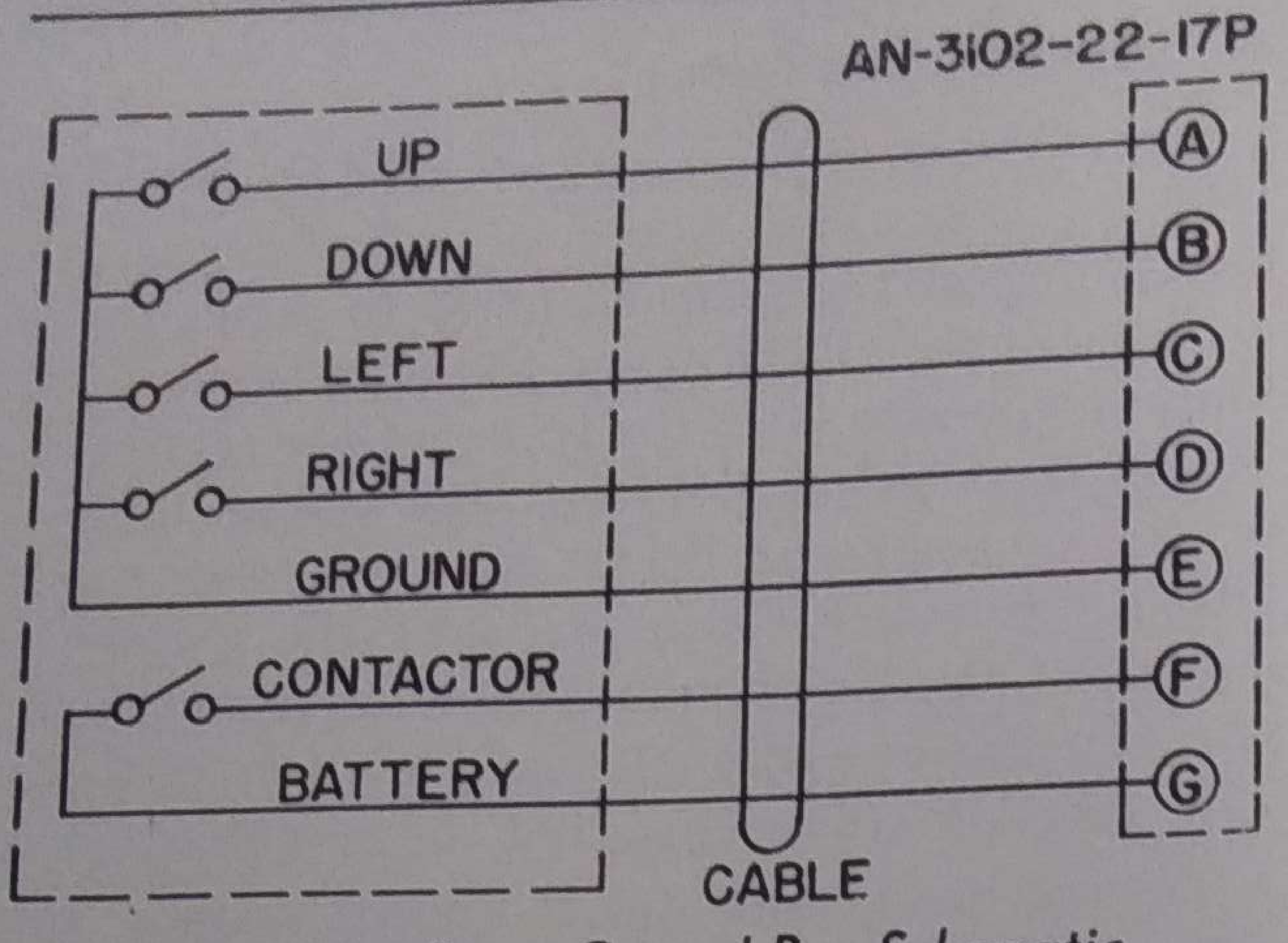

Figure 71—Servo Control Box Schematic.

schematic of this control box is shown in Figure 71. A 14-volt servo storage battery is also required to check the electrical operation of the servo.

The servo should be checked for proper over-all operation prior to its use in a complete assembly. This check-out may be made with the servo mounted in the fuselage and includes the following:

(1) A visual inspection to see that no damage has occurred during shipment.

(2) A check of the electrical circuit which includes the action of the solenoids and the correct response to directional control signals.

(3) A check of the mechanical action of the servo and particularly the proper meshing of the gears in the gear clutch.

(4) A verification that the elevon control rods are adjusted to the proper length.

(5) A check for excessive backlash in the unit.

In order to make a complete check of the above items it is necessary to remove the servo cover to expose the working parts and observe their action during the check-out. However, if the servo appears to be in good condition it is suggested that a check of the limit switch settings, in accordance with the following procedure, be made first. The operation of the servo during this check, in response to control signals, indicates that the electrical circuits are correct and that the mechanical operation is satisfactory. The servo operation should be carefully observed for any evidence of mechanical binding or similar defects.

Limit Switch Check: To make the limit switch check, the servo control box and a 14-volt storage battery must be connected to the servo cables, being sure that all switches on the control box are open before connecting the battery. Proceed as follows:

UP-DOWN Limit Switches:

(1) Close the battery switch on the servo control box and note that the dynamotor and motor run and that the servo arms do not move.

(2) Press the UP (glide) control switch on the servo control box and allow the servo to operate until the servo arms reach their approximate limit in the forward position. Continue this operation gradually by intermittently contacting the UP control switch until the servo arms cease responding. This is done to prevent injuring the mechanism in case the UP limit switch fails to operate or is improperly wired, allowing the servo action to continue to its mechanical limit. If the UP limit switch does not open the circuit, the action of the solenoid attempting to continue servo action will be heard when the UP control switch is closed.

Important: Be sure to release the UP control switch as soon as the mechanism reaches the mechanical stop. If the servo arm is not stopped by the limit switch, the unit must be removed and the corresponding limit switch must be reset or replaced.

(3) Repeat step (2) above by pressing the DOWN control switch.

RIGHT-LEFT Limit Switches: Repeat the procedure as given for the UP-DOWN limit switches above by pressing the RIGHT and then the LEFT switches on the servo control box.

If the above check is not successful, replace the servo with one which functions properly. Instructions for a complete bench check of the faulty servo are given below.

Bench Check and Adjustment: To make an over-all bench check on a SWOD (Servo) Mk 4 Mod 4, the large cover must be removed. All wiring and gears will then be accessible for checking and adjustment.

The solenoid plungers, walking beams and gear cages should be checked for free action. When a plunger is pushed into a solenoid and then released, the centering pawl action should cause the plunger to be withdrawn from the solenoid and the gear cage should return to the neutral position so that

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no gears are engaged. If this action is sluggish or otherwise not prompt and smooth, the centering pawl spring may be too weak, or the solenoid plunger itself may be dirty, damaged, defective, or obstructed, or the gear cage may be misaligned or damaged. The defect should be remedied or the defective part replaced.

The limit switches should be inspected to see that they are unobstructed and that their arms are free and without side play that might cause them to bind on the sides of the switch body or on the servo arm attached to the shackle. If it is not certain that each limit switch is correctly connected in series with its corresponding solenoid, the limit switch wiring check must be made to avoid the possibility of an error in wiring that might cause mechanical injury to the servo mechanism.

If the limit switches are known to be properly connected, the servo control box, with all of its switches open, should be connected to the servo cable connector, and the wires of the battery cable should be connected to the corresponding terminals of a properly charged 14-volt storage battery. No action should take place until the arming switch on the control box is closed, at which time the dynamotor and the motor would start. Observe that the motor rotates in a clockwise direction when viewed from the shaft end. If the motor operates in the opposite direction, do not close any of the control switches, as there will be no limit switch direction and mechanical injury to the unit may result. Reconnect the motor for proper rotational direction by reversing the motor field connections.

If the gear train and solenoid core adjustments are not known to be in proper adjustment, the gear clutch procedure which follows later in this section should be followed.

If there appears to be excessive backlash, or if the end play of the screw shafts is not known to be in proper adjustment, the backlash adjustment procedure which follows on p. 70 should be followed.

If there appears to be any foreign matter in the unit of any kind, it should be removed, and where lubrication is involved it should be done only in accordance with the information on Lubrication under **e**, Maintenance and Care. The plungers and walking beams should never be lubricated, but special lubrication applied in a special manner must be used on the other mechanical parts.

No attempt should be made to adjust the contactor on the servo if a replacement is available.

If all adjustments and checks are satisfactory or have been made satisfactory, the cover should be replaced. The servo is now ready for reinstallation, after which the limit switch check should be repeated.

LIMIT SWITCH WIRING CHECK: Open all of the switches on the servo control box and attach it to the connector on the servo cable. Attach the negative and the plus 14-volt wires to the corresponding terminals on a fully-charged 14-volt storage battery. Remove the compound gear which is driven by the motor or disconnect the 14-volt lead to the motor at the contactor so that the gear train will not be operative. Close the arming switch on the control box and the dynamotor and motor should start, unless the motor has been disconnected. Close the RIGHT switch on the control box and the right solenoid should be energized. Carefully operate the arm of the right limit switch (see Figure 60), being careful to avoid bending the arm by moving it too far past the point of switching action. The right solenoid should be deenergized when the right limit switch is opened. Repeat this operation for each of the other limit switches. If each limit switch will open the circuit of its corresponding solenoid, the wiring of the limit switches is correct.

LIMIT SWITCH ADJUSTMENT: If the limit switches have not been preadjusted, or have been found to have become misadjusted, it will be necessary to bend the arms of the switches carefully so that the switch will open at the point corresponding to some particular position of the servo linkage arms. The bending should be done on the switch arm out from the body of the switch. Great care must be taken in this process, since it is possible to damage the mechanism if the switch arm is bent far enough to allow the mechanism to reach its mechanical limit before the solenoid circuit is opened. The limit switch wiring check outlined above must be made unless it is known that the wiring is satisfactory.

If it is known that the switches are nearly in adjustment, and it is necessary to correct only one

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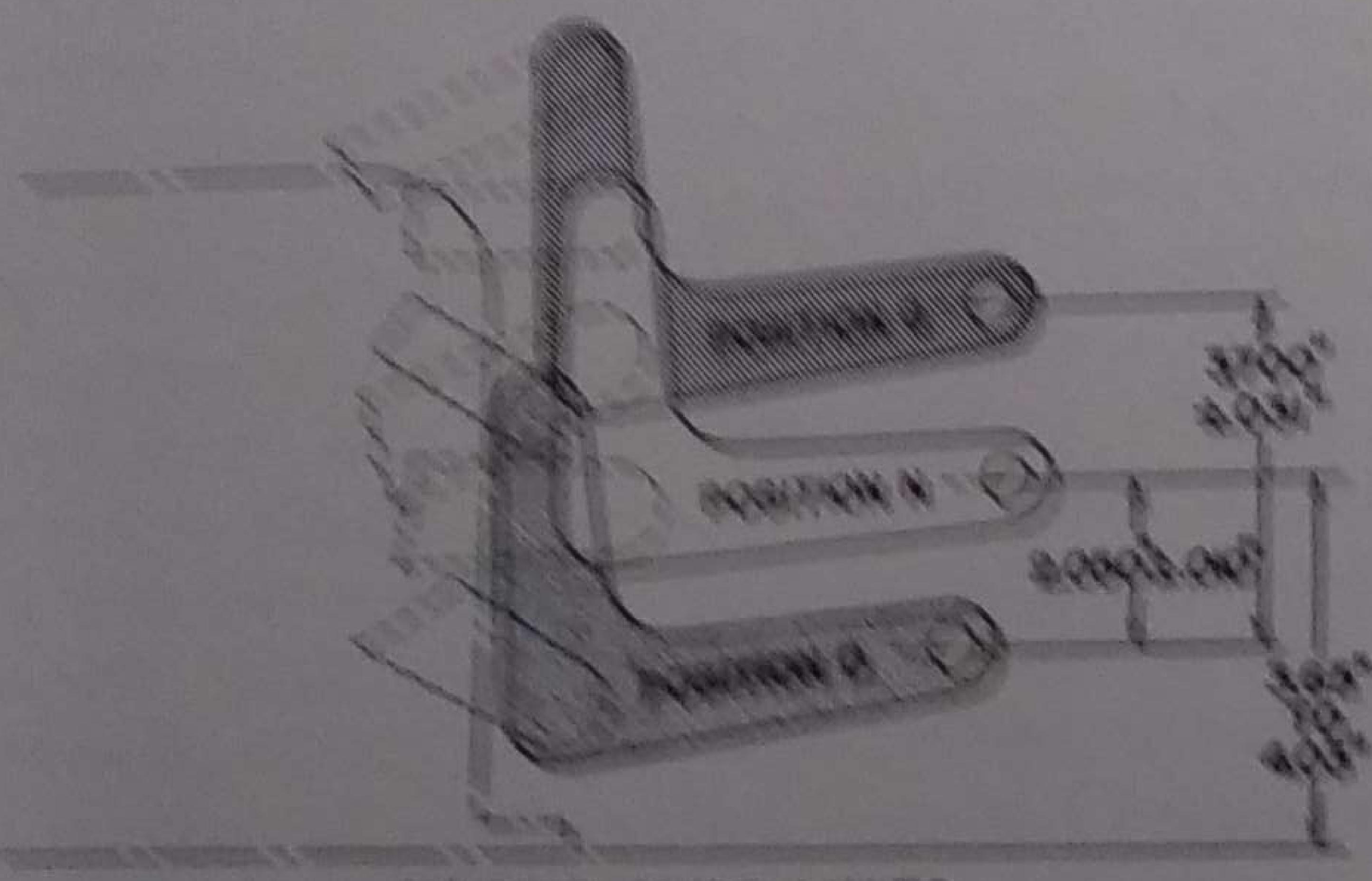
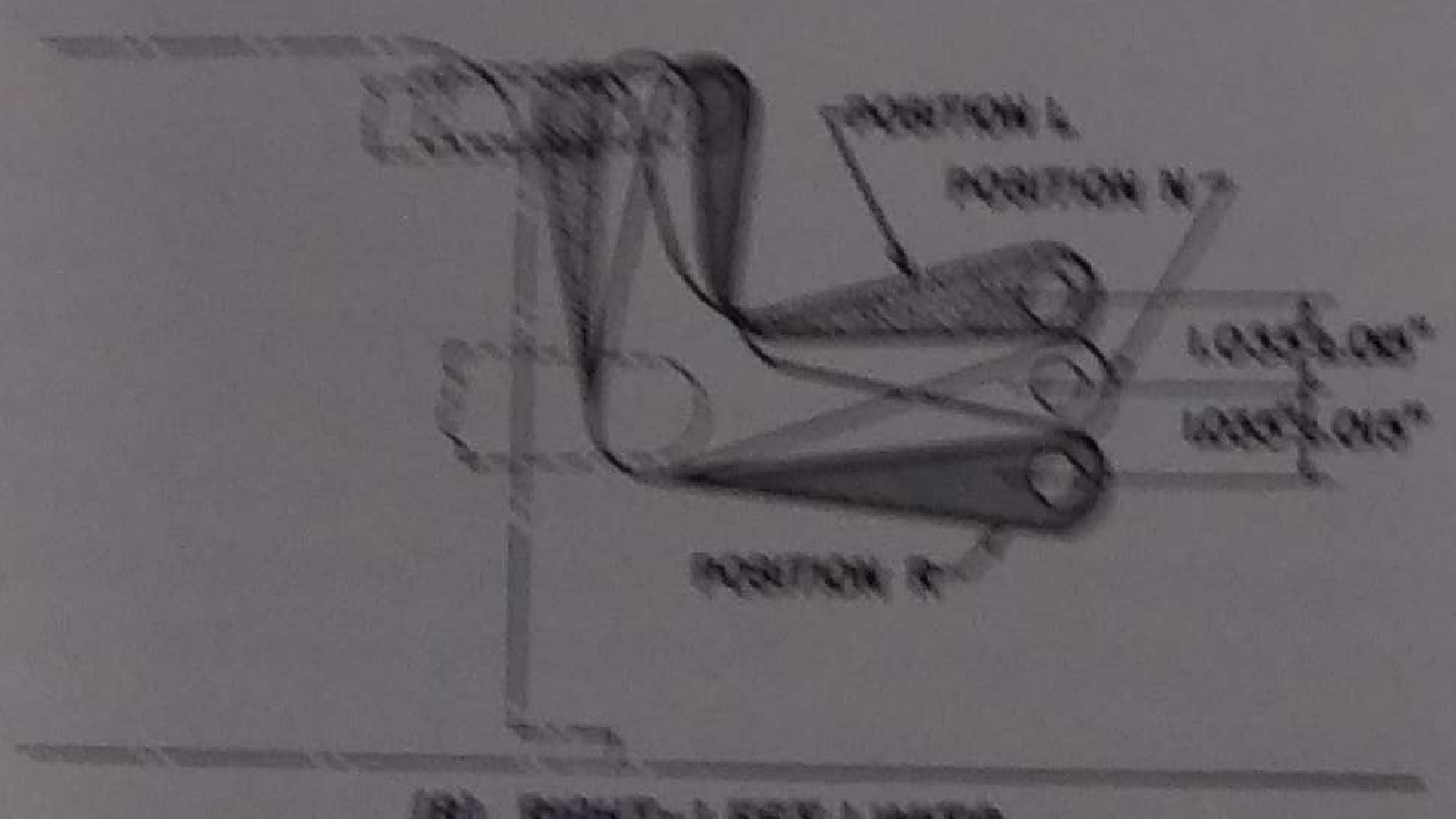
of two switch adjustments, all arms that are not known to be in adjustment must be bent toward the servo arm sufficiently to assure protection to the mechanism. Otherwise, it should be assumed that the arms have not previously been adjusted, and each switch arm should be bent in toward the servo arm to allow short travel sweep to assure that the control circuit to the solenoid involved will be opened before the corresponding mechanical limit of travel is reached.

To make this adjustment, place the servo with its mounting surface flush against a wide plane surface so that accurate measurements may be made to determine the perpendicular distance from the plane surface to the middle of the holes in the ends of the servo arms to which the elevon control rods normally attach, as shown in Figure 72.



(A) DIVE-GLIDE LIMITS



(B) RIGHT-LEFT LIMITS

Figure 72—Limit Switch Adjustment

Open all of the switches on the servo control box and attach it to the servo cable. Connect the power cable to a 24-volt storage battery. Close the arming switch on the servo control box and observe that the motor shaft rotates in a clockwise direction when viewed from the front end to which the gear is attached. Open the arming switch again.

Set the servo in its NEUTRAL position by keying both screw shafts, using the key provided with each unit, until the lines scribed across the ends of the two servo driveshafts, at the back of the unit, are in alignment with the lines scribed on their respective bushings, as shown in Figure 67. The holes in the ends of the servo arms should now be equidistant from the plane mounting surface for a condition of Right-Left neutral.

The Right-Left screw shaft is located on the right side of the motor, the side nearest the end of the servo at which the control cable enters the unit, and controls the Right-Left servo action. The dive-glide screw shaft is located on the left side of the motor, the side nearest the dynamotor, and controls the dive-glide servo action.

To set the UP and DOWN limit switches, close the arming switch on the servo control box to start the motor and dynamotor. Then proceed as follows, being sure that the condition of Right-Left neutral is maintained at all times during the first three steps:

(1) Press the DOWN control switch and operate the servo until the DOWN limit switch opens the circuit of the DOWN solenoid, stopping the servo action. Key the dive-glide screw shaft manually and determine the number of turns required to reach the mechanical stop. Press the UP control switch until the servo linkage returns to about the neutral position. Readjust the arm of the DOWN limit switch, shown in Figure 60, by carefully bending it a slight amount and rechecking the point at which the switch opens the circuit. Repeat this procedure until the switch opens the circuit. One turn, ± ⅛ turn, from the mechanical limit in that direction. The DOWN limit switch is then in adjustment, and the position of the right servo arm, when the DOWN limit switch stops the servo action, is designated as position "D", as shown in Figure 72-A.

(2) Press the UP control switch and operate the servo until the UP limit switch opens the circuit of the UP solenoid, stopping the servo action. Measure the distance from position "D" to the center of the hole in the right servo arm. By carefully bending the UP limit switch arm slightly and repeating the procedure as many

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times as may be necessary, adjust the setting of the UP limit switch arm so that this distance is 3.700 inches, ±0.031 inch. By keying the screw shaft manually, check that from ¾ to 1¼ turns will be required to reach the mechanical limit in this direction. If these requirements are met, the UP limit switch is in adjustment, and the position of the right servo arm when the UP limit switch stops the servo action is designated as position "G", as shown in Figure 72–A.

(3) By pressing the UP and DOWN control switches as required, or by keying the dive-glide screw shaft manually, set the servo linkage so that the center of the hole in the end of the right servo arm will be 2.050 inches, +0.010 inch, from position "D". The lines scribed across the end of the dive-glide servo driveshaft and its bearing should be in alignment, and the distances from the center of the holes in the ends of the two servo arms to the plane mounting surface should be equal and fall within the range from 3.65 inches to 4.03 inches. If these requirements are satisfied, the servo is in its neutral position, and the position of the servo arms is designated as position "N" in Figures 72–A and 72–B.

To set the RIGHT and LEFT limit switches, proceed as follows, being sure that the condition of dive-glide neutral is maintained during steps (4) and (5) below:

(4) Press the LEFT control switch until the servo action is stopped by the opening of the LEFT limit switch. Measure the distance from the center of the hole in the end of the the right servo arm to the neutral position "N". Bend the LEFT limit switch arm slightly and repeat this procedure as often as is necessary to cause the LEFT limit switch to stop the servo action at a distance of 1.035 inches, ±0.015 inch, from position "N". Key the Right-Left screw shaft manually, and check that ¾ to 1¼ turns is required to reach the back mechanical stop after the LEFT limit switch opens the circuit stopping servo action. If these specifications are met, the LEFT limit switch is in adjustment and the point at which the LEFT limit switch causes the servo action to stop may be designated as position "L", as shown in Figure 72–B.

(5) Press the RIGHT control switch until the servo action is stopped by the opening of the RIGHT limit switch, and measure the distance from position "N". Adjust the arm of the RIGHT limit switch by bending slightly and repeating as often as necessary to cause the servo action to be stopped at a point 1.035 inches, ±0.015 inch, from position "N". This point may be designated as position "R", as shown in Figure 72–B, provided from ¾ to 1¼ turns is required to key manually the Right-Left screw shaft to the front mechanical stop. The RIGHT limit switch is then in adjustment.

Adjustment of Gear Clutch: Before adjusting the gear clutch, the operation of the plungers, walking beams, gear cages, and centering pawls should be checked. Each of the plungers should be pushed into its solenoid in turn, observing that when it is released the gear cage is promptly returned to its neutral or disengaged position by the action of the centering pawl. If the action is sluggish, or if the gears remain engaged when the plunger is released, the plungers may be binding due to inaccurate manufacture, dirt, corrosion, obstructions, or a weak pawl spring. Appropriate action should be taken to correct the defect.

To adjust the gear clutch, use the servo control box and battery arrangement described at the beginning of **d**, Adjustment and Testing. With all switches of the control box in the OFF position, connect the control box and battery and proceed as follows:

(1) Disconnect the 14-volt lead to the motor at the contactor in the servo so that the dynamotor may be operated with the driving motor at rest.

(2) Remove both compound gears from their respective studs to expose the gear train at the point of clutching engagement.

(3) Place dummy pinions of the same size as the compounding pinions on the compound gear studs in a position to engage the cage gears, Figure 73.

(4) With the right control solenoid energized to engage its pinion, slowly back off the solenoid adjusting screw with a screwdriver while the dummy pinion and reversing gear are rotated slowly manually until the gears start to bind.

(5) Screw the solenoid adjustment inward until the binding on the gears is *just relieved*. This

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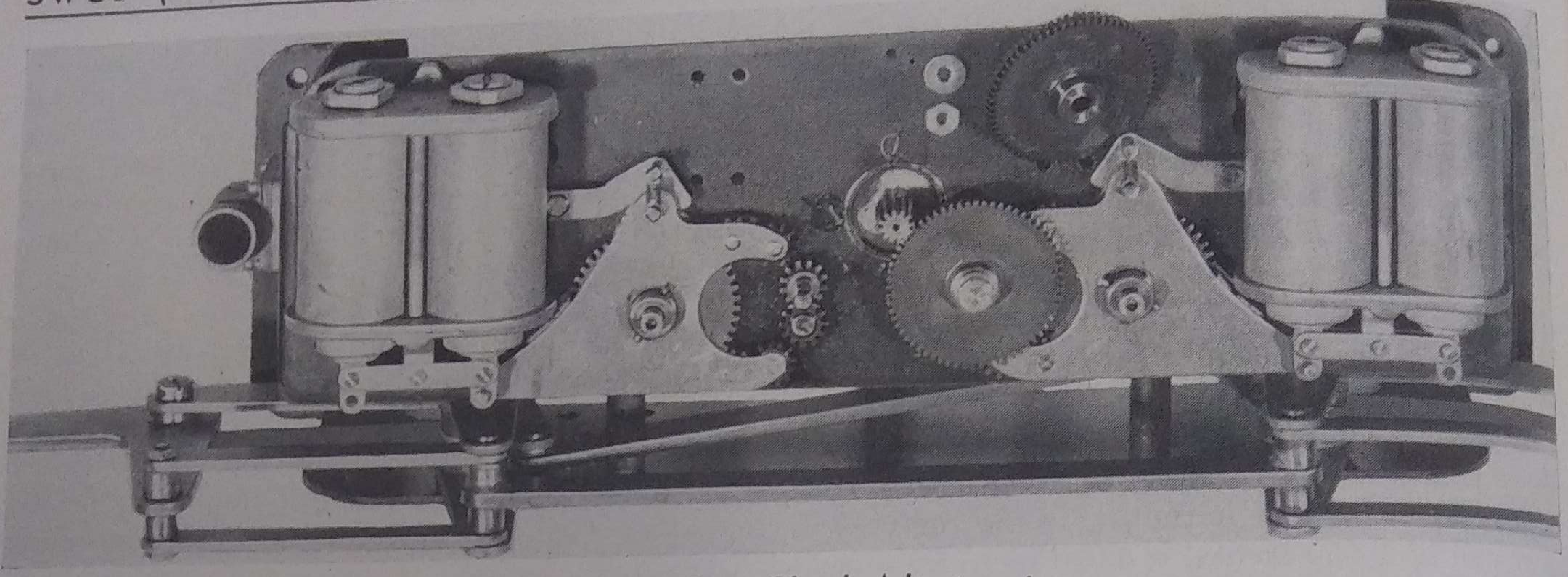

Figure 73.—Gear Clutch Adjustment

point can be determined very definitely by manual manipulation of the gears.

(6) Continue to screw the solenoid adjustment inward 60±15 degrees, to provide running clearance for the gears.

(7) Lock the solenoid core with the locknut in this position.

(8) After locking the solenoid, check the mesh f the tengaging gears visually by slightly oscilslating hem manually. They should not bind nor ohould they have more than about 0.0005-inch backlash.

(9) Repeat (1) through (7) for the other three solenoids.

(10) Replace the compound gears. Prick punch the nuts holding the compound gears on their studs to insure their remaining in place. Later units of this servo are equipped with a tie bar or plate connecting the compound gear studs on the outside of the gears. This tie bar reenforces the gear studs and permits the use of a lockwasher under the gear-retaining nut, thus eliminating the need for prick punching this nut.

(11) Replace the 14-volt lead to the motor at the contactor. This lead is secured by a copper nut and bolt at the contactor so care must be taken to avoid stripping the threads.

After all the solenoids have been adjusted, the key should be applied to each of the screw shafts in turn, and the assembly operated manually to observe that they rotate uniformly with only a slight bind, and without catching or locking. Rough action may be caused by dirt in the gear teeth; therefore, it is essential that the gears be kept absolutely free of any foreign matter.

Backlash Adjustments: The maximum backlash allowed in manufacture of the servo unit, expressed in terms of backlash motion at the ends of the servo arms, is 0.04 inch. If a servo appears to have excessive backlash as indicated by play in the elevons when connected, it should be inspected closely to determine the source of play. The manual adjustment key should be applied to each screw shaft in turn and the amount of backlash motion at these points checked. When properly adjusted, there should be no end thrust allowed for the screw shafts. They should be adjusted to the point where they barely begin to bind. This adjustment is made by loosening the locknuts at each end of the adjustable tie rod located directly above each screw shaft (Figure 60). This rod should then be screwed farther into the rear screw shaft bearing support to tighten the adjustment, or screwed out to loosen it. The locknuts at both ends of the rods should then be retightened.

An inspection should be made at all points in the servo linkage, at the drive shafts, at the traveling nut and shackle, and at all other points where play might take place. Any defective part should be repaired or replaced.

e. Maintenance and Care

SWOD (Servo) Mk 4 Mod 4 (PU–145/DPN–1) is so designed and constructed that normally it

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will require very little maintenance in the field, and it presents no problems as to care. The unit can be shipped safely installed on the air stabilizer or packed in a shipping box or carton. It should be protected against direct blows and heavy dropping or crushing, and should be protected against moisture and corrosive agents. The unit is not watertight, and thus will not stand immersion or direct applications of water. While the covers are fairly dusttight, the units should not be subjected to excessive dust or grit conditions.

SWOD (Servo) Mk 4 Mod 4 (PU–145/DPN–1) will normally not require lubrication in the field, unless some abnormal conditions make it necessary to remove and replace the lubrication. In such cases the old lubrication should be removed with kerosene, removing only as much as is necessary. It should be replaced by heating the parts to be lubricated with a soldering iron or hot iron and then applying Alemite No. 29 oil. To lubricate the removable parts, place them in the hot lubricant until they are heated, and then remove the part and shake off the excess. Direct flame should never be applied, and no attempt should be made to apply low-temperature lubricants at room temperature. The solenoid plungers and walking beams should never be lubricated, since the presence of oil or grease causes dirt and grit to collect on these parts.

9. SWOD (CONTROL SYSTEM) MK 18 MOD 1 (Flight Control Servo PU–146/DPN–2)

The SWOD (Control System) Mk 18 Mod 1 shown in Figure 74 with cover removed, is a combined gyro-servo control unit that is used with SWOD (Special Weapon Mk 9 Mod 1). Figure 75 shows the SWOD Mk 18 mounted in the air stabilizer.

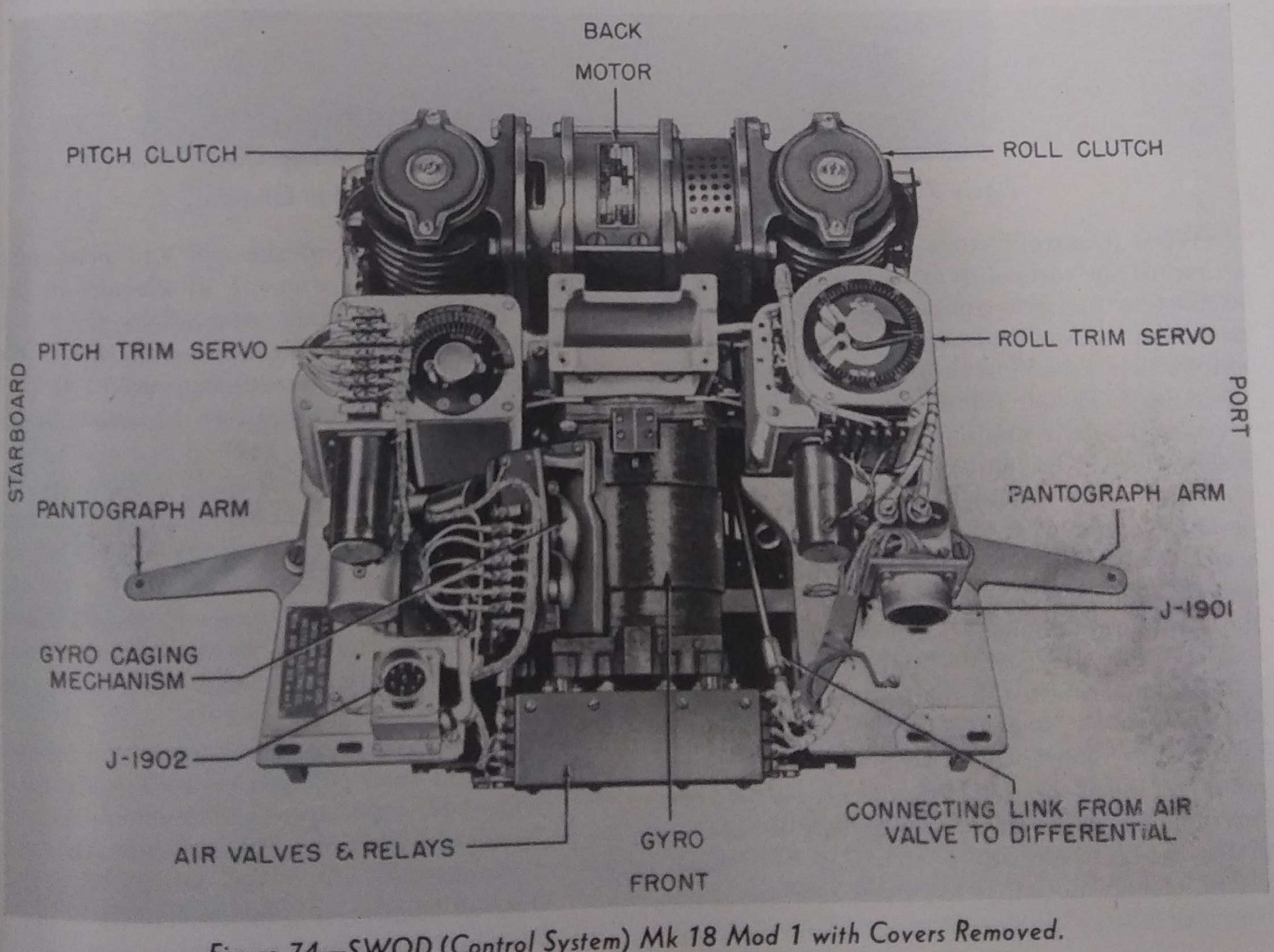

Figure 74—SWOD (Control System) Mk 18 Mod 1 with Covers Removed.

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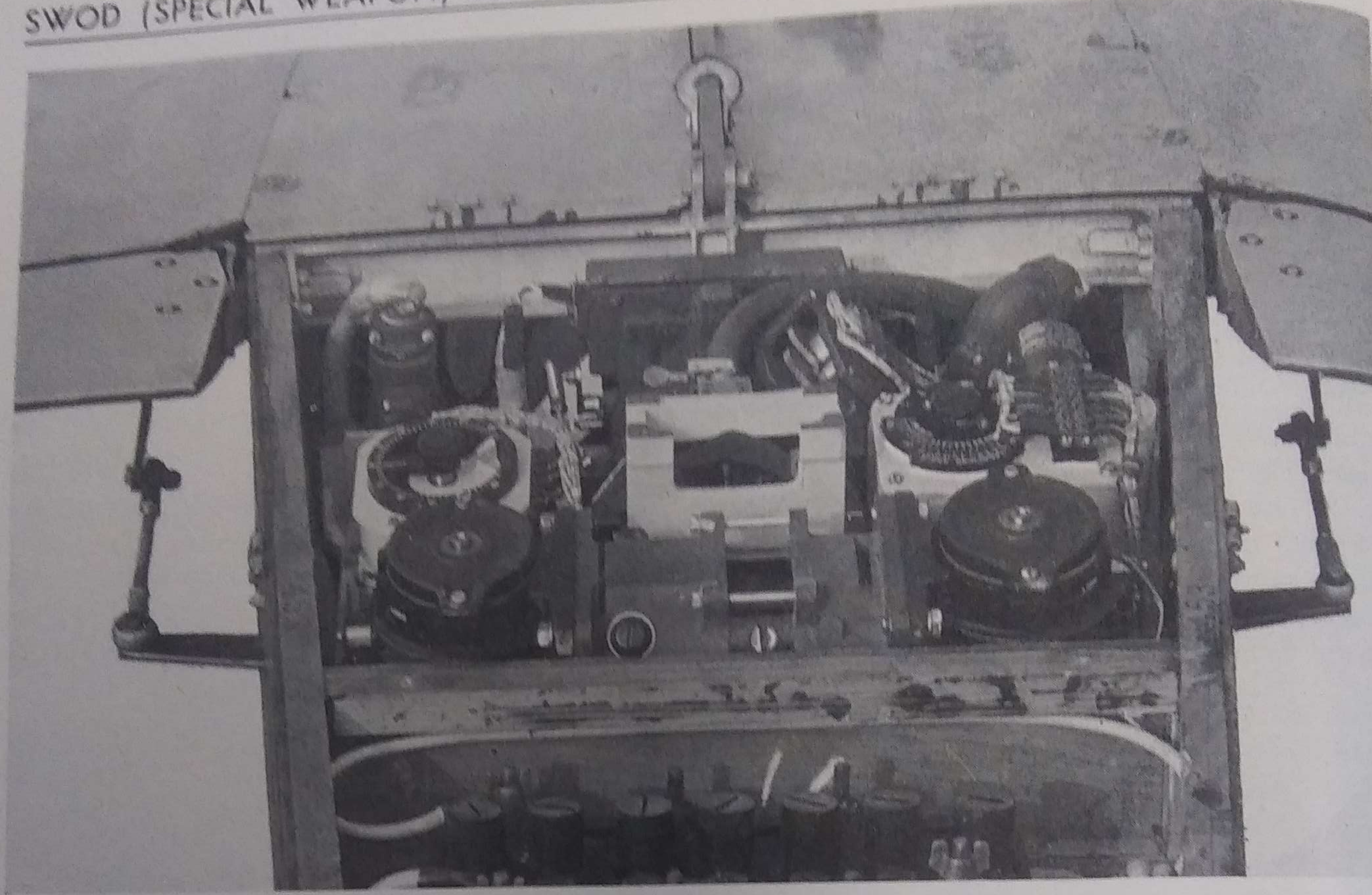

Figure 75—SWOD (Control System) Mk 18 Mod 1 Installed in Glider.

SWOD (Control System (Mk 18 Mod 1 utilizes an air-driven vertical gyro with rotary air valves coupled to the gyro gimbals to measure the roll and pitch motions and utilizes roll and pitch trim units which respond to the directional signals from the radar. The air valve consists of a pilot which is coupled to the appropriate gyro gimbal and a sleeve which is driven by external means. If the pilot and sleeve of either valve are not aligned, a pressure differential is established across the appropriate air relay which in turn activates an electromagnetic clutch of the servo motor to drive the pantograph linkage and the elevons as required. The sleeve on each air valve is driven by differential gears in the roll and pitch trim units of the control system. These trim units, in response to directional control signals from the radar, establish the required trim angles for accurate homing of the missile by moving the sleeves of the two gyro air valves.

The elevon motion is fed back through a mechanical linkage to the air valve sleeves through the differential gears of the roll and pitch trim units. Thus, the movement of elevons in the proper direction and amount realigns the sleeve with the pilot of the air valve and keeps the elevons in the proper position to effect the required change in flight path or to maintain the existing flight path.

10. BOMBS AND FUZES

a. General Purpose Bomb AN–M65

General: The 1,000-pound General-Purpose Bomb AN–M65, minus the fin assembly and trunnion band is the pay load which is carried in the SWOD Mk 9 missile (Figure 76).

The characteristics of this bomb are as follows:

Explosive used—Torpex or TNT.
Weight of shell—approx. 550 pounds.
Total weight torpex loaded—975 to 1,025 pounds.
Over-all length—53.1 inches.
Diameter of body—18.8 inches.

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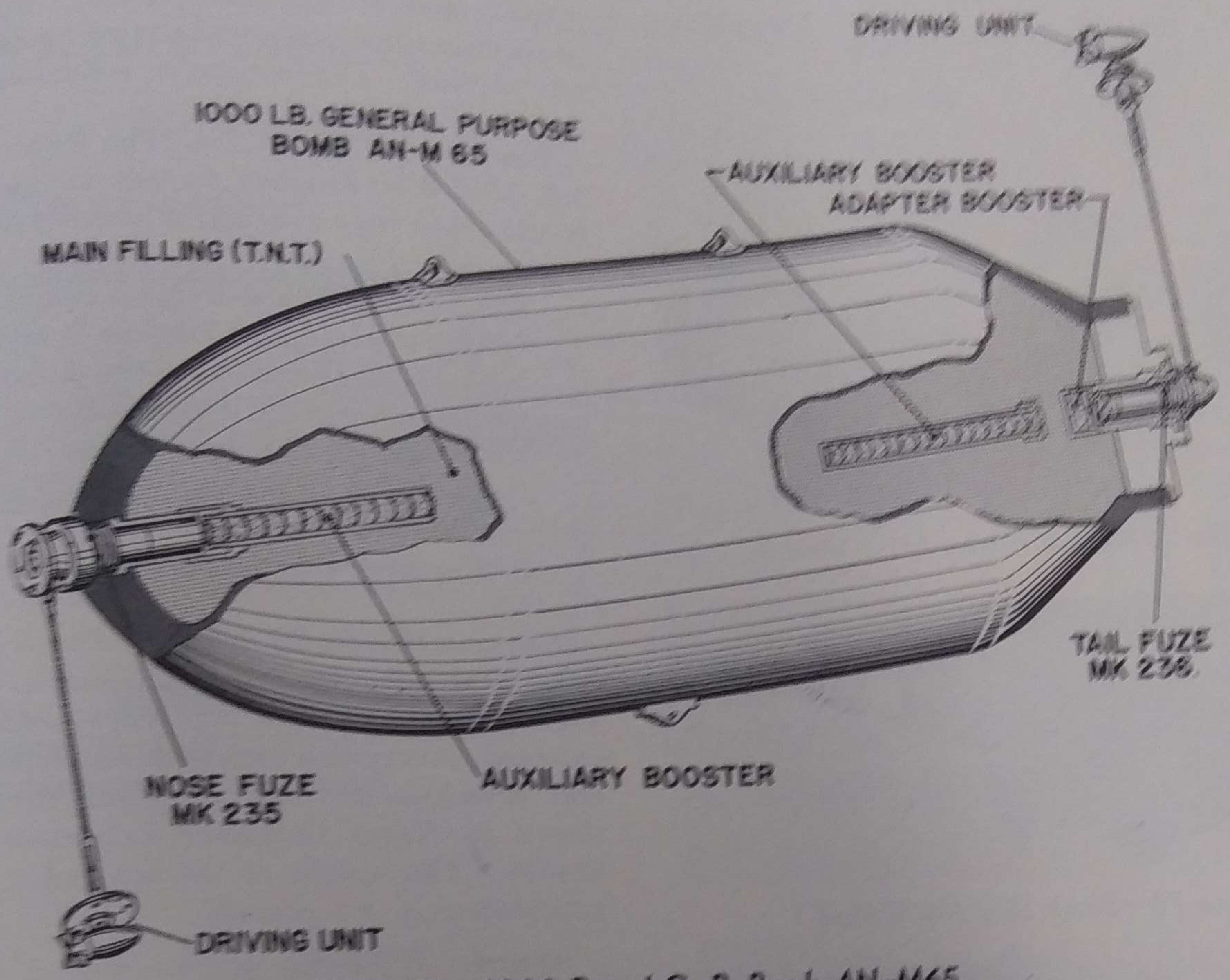

Figure 76—1000-Pound G. P. Bomb AN-M65

Wall of thickness—0.5 inch.

Explodes on impact.

Two suspension lugs spaced 14 inches apart are welded to the bomb body for horizontal suspension of the bomb. A single horizontal suspension lug is also welded to the bomb case at the center of gravity and diametrically opposite the dual lugs to fit British release devices. When the fin assembly and trunnion band are removed from the bomb for use with SWOD Mk 9 the center of gravity moves about ½ inch forward of the single suspension lug. Since the bomb is held in the SWOD Mk 9 by bomb straps, the suspension lugs are used for positioning the bomb in the air stabilizer rather than for suspension.

Preparation of Bomb for Mounting: The 1,000-pound Bomb AN-M65 uses Adapter Booster M115 for the tail fuze. The booster cup for the nose fuze comes installed.

In the nose fuze the arming screw (information on fuzes follows in b, p. 74) is free to swing around in any position and thus can readily be turned to the correct location for connecting to the arming device connector. However, in the tail fuze the arming screw will not swing freely but is tight and fixed. If, when the fuze is inserted, the arming screw is not in position for attaching to the arming device connector, loosen the fuze, and turn to the proper position and screw down the set screws.

The fuze should be placed in the adapter before installing the bomb in the air stabilizer.

Instructions for mounting the bomb in the air stabilizer may be found in chapter 4, 1a. p. 81. Figures 77, 78 and 79 show bomb handling equipment which is used in transporting and mounting the bomb.

If the fuze should accidentally become armed in flight the SWOD Mk 9 may be jettisoned. However, if after landing it is observed that the fuzes are armed, precautions should be taken as with

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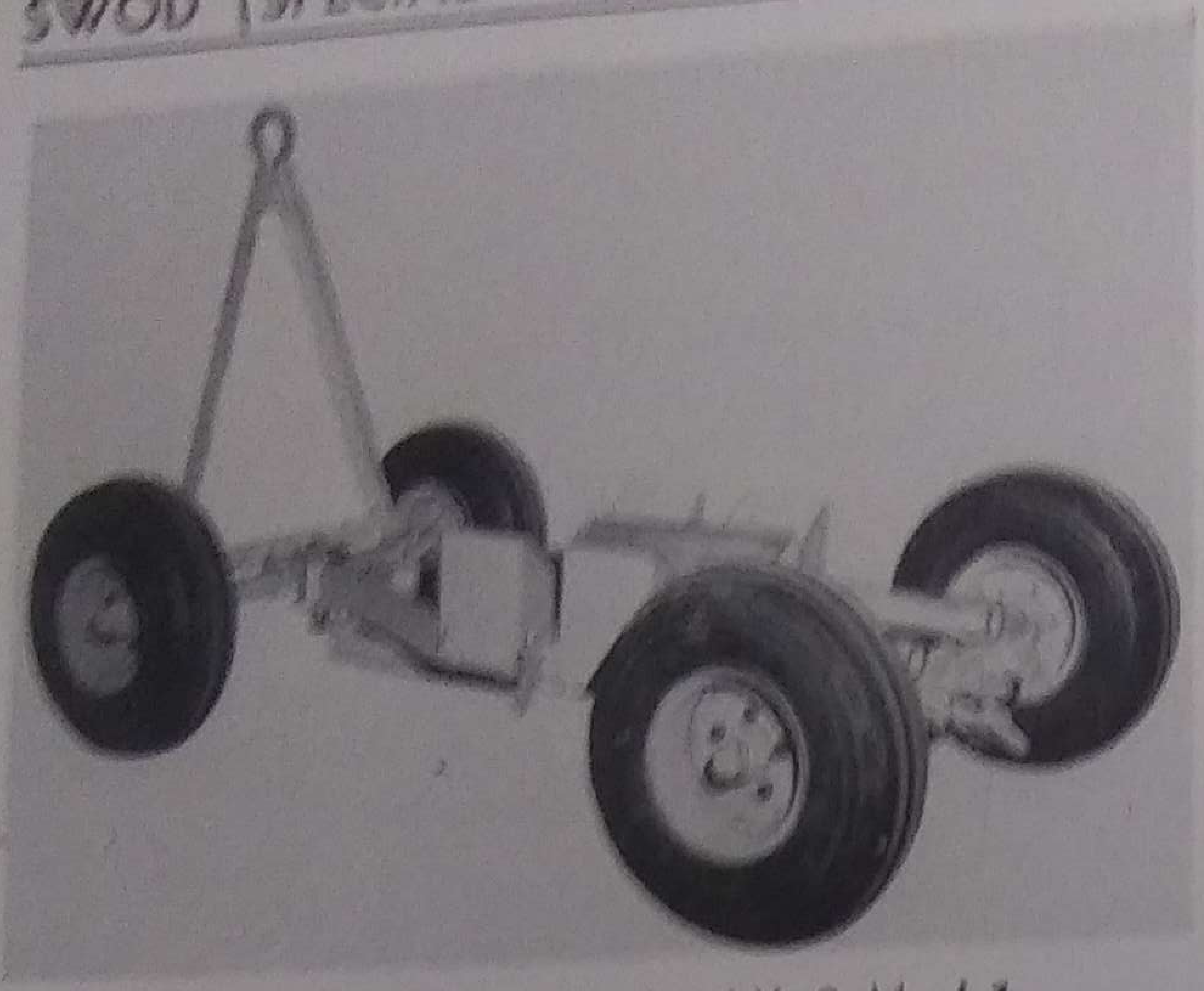

Figure 77—Bomb Trailer Mk 2 Mod 1.

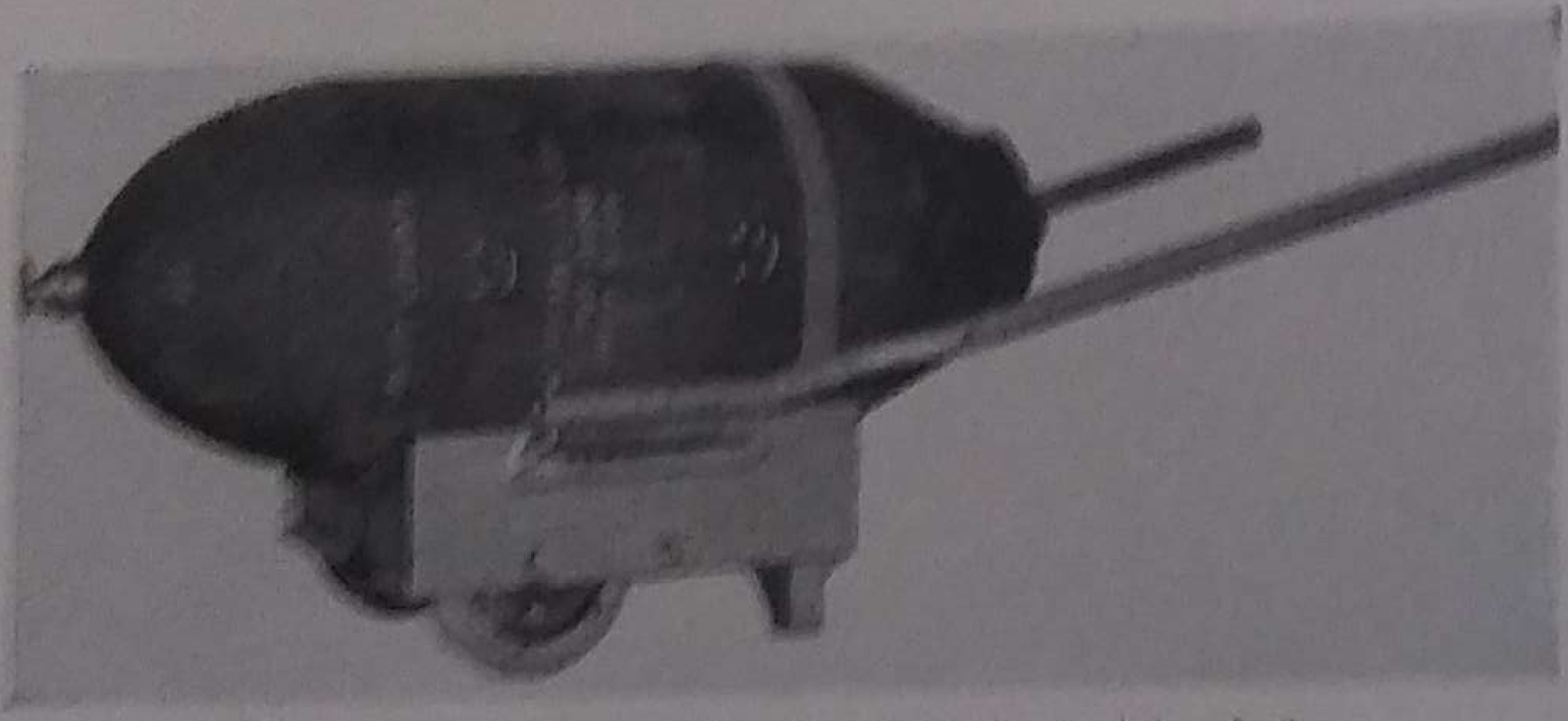

Figure 78—Bomb Skid Mk 1 Mod 1.

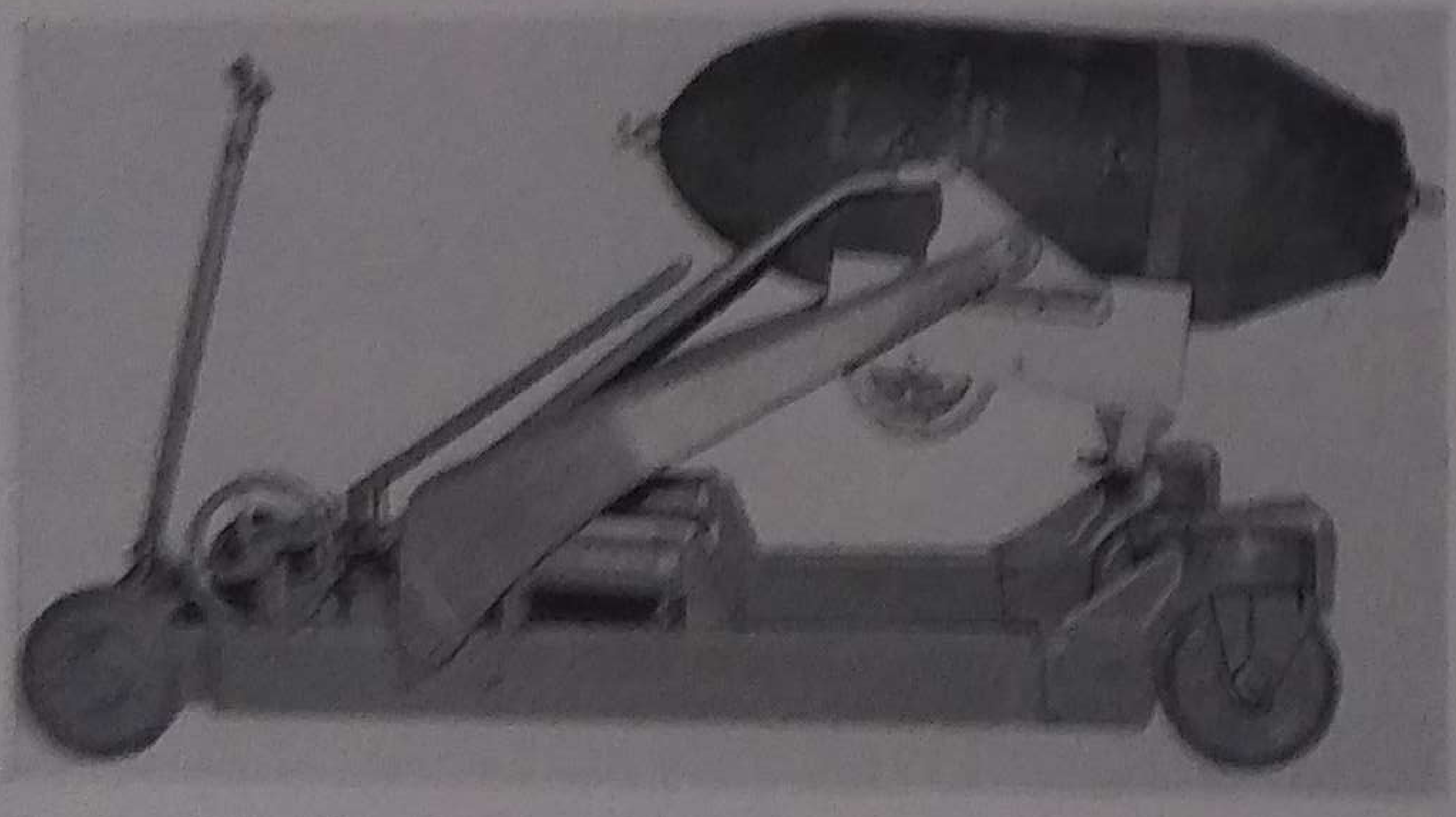

Figure 79—Bomb and Torpedo Trailer Mk 2 Mod 2.

any other bomb fuze. The tail fuze can be removed while the airframe is still suspended to the plane. The nose fuze is an impact type fuze and may be removed after the airframe is lowered to the ground and the air stabilizer is removed.

b. Special Bomb Fuze Mk 235

General: The Mk 235 Mod 0 is a bomb nose fuze of air arming type requiring approximately 2,500–3,000 feet of air travel to arm. Functioning of the fuze when armed is initiated by impact with any surface. Detonation is accomplished with a 0.02 second delay.

Bombs in Which Used: The Bomb Fuze Mk 235 Mod 0 is designed for use in the following bombs when they are used in missiles of the BAT type:

500 pound General-Purpose Bomb AN-M43.
1,000 pound General-Purpose Bomb AN-M44.
2,000 pound General-Purpose Bomb AN-M34.
500 pound General-Purpose Bomb AN-M64.
1,000 pound General-Purpose Bomb AN-M65. (Used regularly with SWOD Mk 9 Mods 0 and 1.)
2,000 pound General-Purpose Bomb AN-M66.

Details: Figure 80 shows the Bomb Nose Fuze Mk 235 Mod 0 in the armed and unarmed position. Figures 81 and 82 show this fuze assembled to the external driving unit which arms the fuze. General arrangement with principal dimensions is shown in Naval Ordnance Laboratory drawing 344638.✓ The weight of the fuze when loaded is approximately 4.5 pounds.

Arming: When the arming wire is withdrawn from the external driving unit, the air flow causes the vanes to rotate and turn the flexible shaft through a reduction gear. This shaft unscrews the arming screw. After the arming screw is completely removed from above the spring loaded arming shaft, the shaft rises and allows the slider to move into position underneath the delay element and above the booster lead-in. Detents lock the slider into position once it is under the delay element. The flexible shaft and arming screw continue to turn freely upon completion of arming without further effect on the fuze.

Explosive Components: The explosive components consist of a delay element of approximately 0.02 second, a detonator contained in the slider, a booster lead-in, and booster of 1.87 ounces of tetryl.

Means of Detonating: Upon impact, the nose plate and striker are shoved in, forcing the split ring open. This allows the striker block to hit

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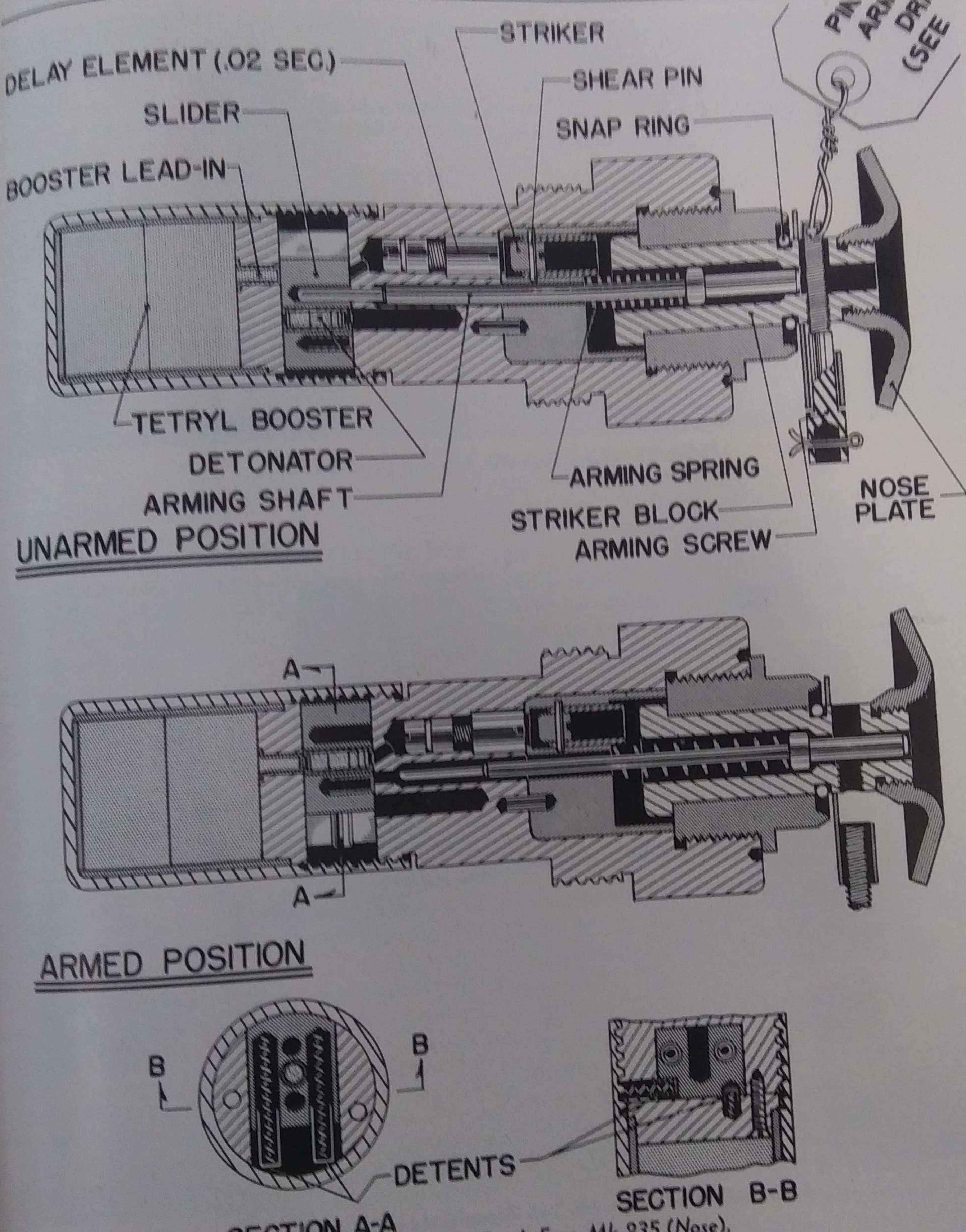

Figure 80—Bomb Fuze Mk 235 (Nose).

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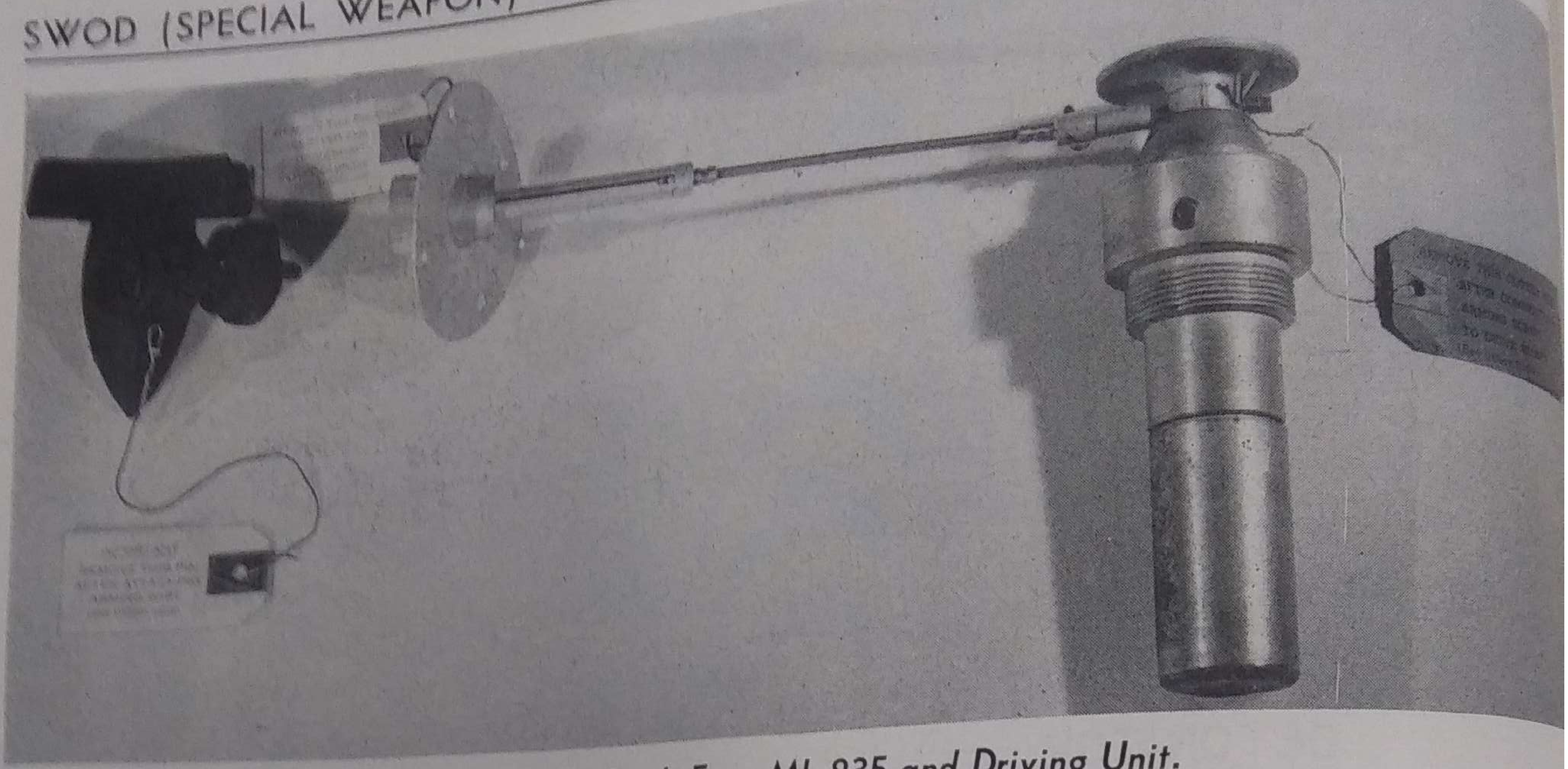

Figure 81—Bomb Fuze Mk 235 and Driving Unit.

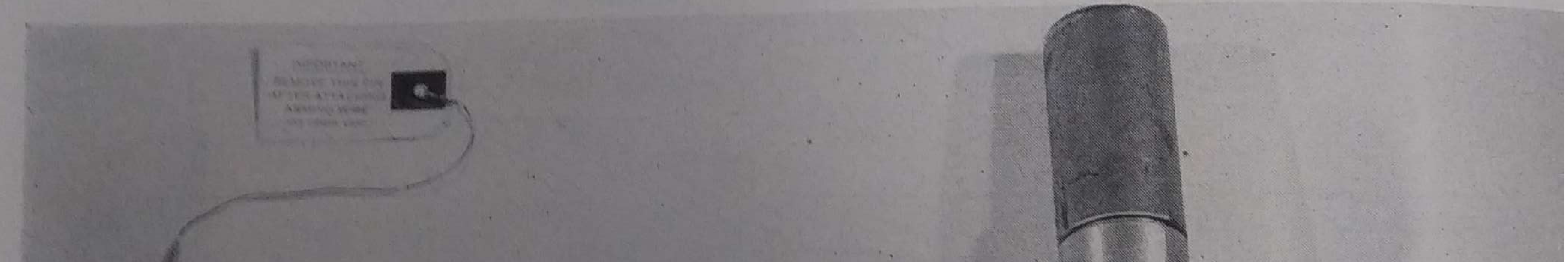

Figure 82—Bomb Fuze Mk 235 Assembled to Driving Unit.

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the striker with force enough to break the shear wire. The striker then hits the delay primer and 0.02 second later the fuze detonates. This fuze is extremely sensitive when armed and requires only a slight impact to detonate it.

Safety Features: When installed in the bomb, the fuze is in the unarmed condition. The arming wire retains a spring loaded safety pin in place, which locks the arming vane. The locked arming vane prevents rotation of the flexible shaft and the arming screw. If the delay element should be initiated prematurely for any reason while the fuze is in the unarmed condition, the shock of the detonator's explosion would be prevented from being transferred to the booster by the slider block, which effectively prevents initiating of the booster lead-in. If the detonator in the slider should be initiated prematurely with the slider in the safe position, the gases would expand into a hole directly over it in the fuze body and no further action would take place.

Safety Features During Shipment: The fuze is assembled in the unarmed condition and it remains so during shipping and stowage. Until the bomb is completely fuzed, the arming screw is prevented from rotating by a cotter pin which passes through it. This arming screw prevents the arming shaft from rising and thus prevents the fuze from becoming armed.

Armed or Partially Armed Fuzes: In the unarmed condition, the arming screw extends completely through the striker stem. As the fuze arms, the arming screw is removed from the striker stem and, when fully armed, the screw will be removed completely from the striker stem. No attempt should be made to unarm this fuze. If the arming shaft has been released, allowing the slider detonator to become aligned beneath the delay element, the fuze must be disposed of in the safest way possible and considered unfit for service use.

Installation in the Bomb: Procedure for installation of the nose fuze may be found in chapter 4, page 84–6.

Servicing: No servicing of this fuze is authorized or necessary. It is not recommended that any lubricating of the driving unit or arming screw be done since this varies the arming distance. Disassembly of this fuze is not authorized.

c. Special Bomb Fuze Mk 236

General: The Mk 236 Mod 0 is a bomb tail fuze of the air arming type requiring approximately 2,500–3,000 feet of air travel to arm. Functioning of the fuze when armed is initiated by deceleration of the bomb. Detonation is accomplished with approximately 0.015 second delay.

Bombs in Which Used: The Bomb Fuze Mk 236 Mod 0 is designed for use in the same type bombs as listed for the nose fuze.

Details: Figure 83 shows the Bomb Tail Fuze Mk 236 Mod 0 in the armed and unarmed condition. Figures 84 and 85 show this fuze assembled to the external driving unit which arms the fuze. General arrangement with principal dimensions is shown on Naval Ordnance Laboratory dwg. 344691. The weight of the fuze unloaded is approximately 2.25 pounds.

Arming: When the arming wire is withdrawn from the external driving unit the vane locking pin jumps out and frees the external wind vanes which drive the flexible shaft, which in turn uncrews the arming screw. After the arming screw is completely removed from the fuze body, the fuze is armed. The flexible shaft and arming screw continue to turn freely upon completion of arming without further effect on the fuze.

Explosive Components: The explosive components consist of a delay primer, a delay element of approximately 0.015 second and a detonator.

Means of Detonation: Upon impact, the striker housing moves forward due to its momentum and when the striker locking balls are opposite the recess in the fuze body the balls are forced out, allowing the spring loaded striker to impact the delay primer. When armed this fuze is extremely sensitive.

Safety Features: When installed in the bomb, the fuze is in the unarmed condition. The arming wire retains the spring loaded safety pin which locks the vanes of the external driving unit. The locked vanes prevent rotation of the flexible shaft and the arming screw. The detonator is not out of line with the striker, but since this is a tail fuze it is considered sufficiently safe because of the strength of the fuze body.

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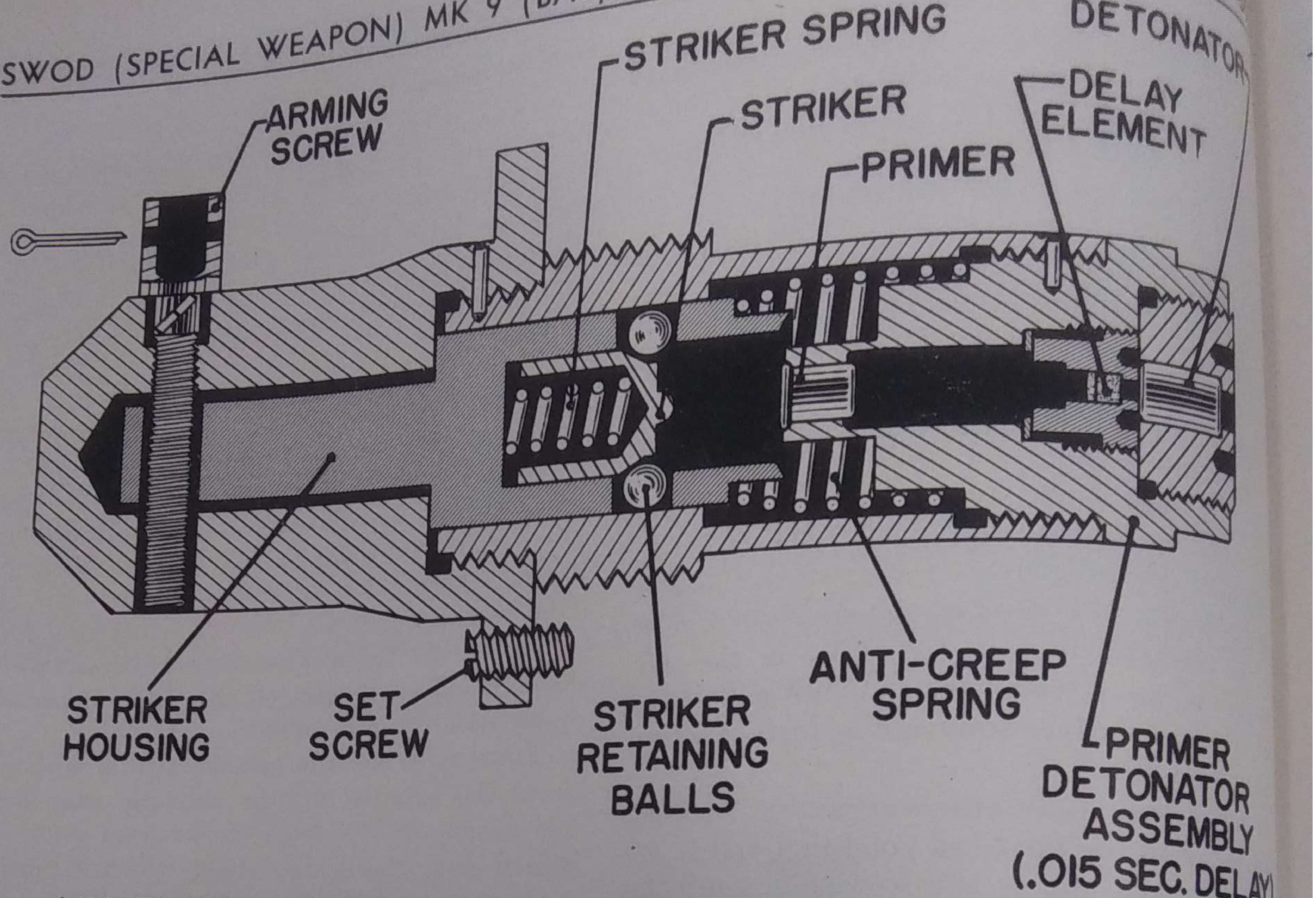
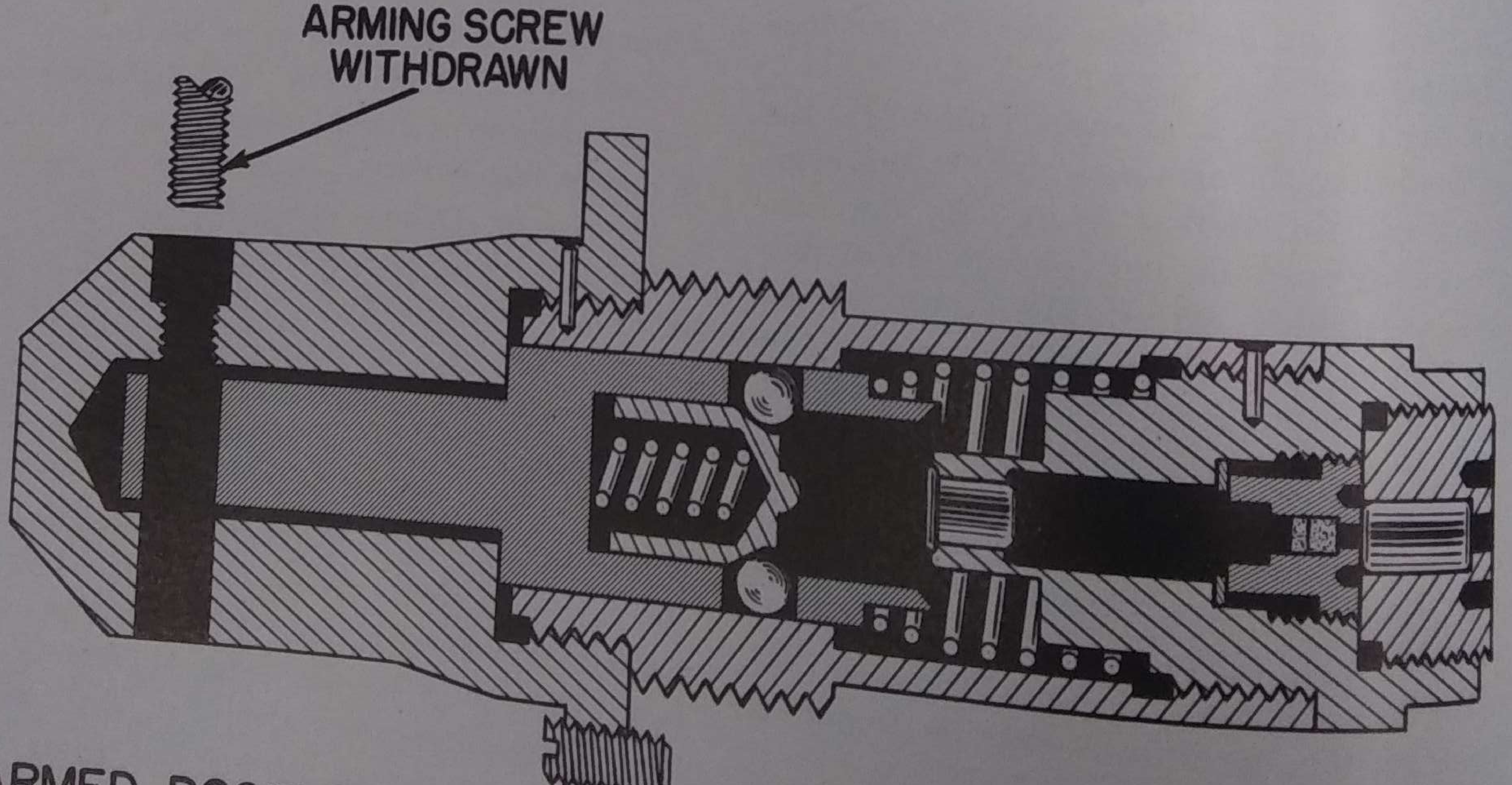


UNARMED POSITION



ARMED POSITION

Figure 83—Bomb Fuze Mk 236 (Tail).

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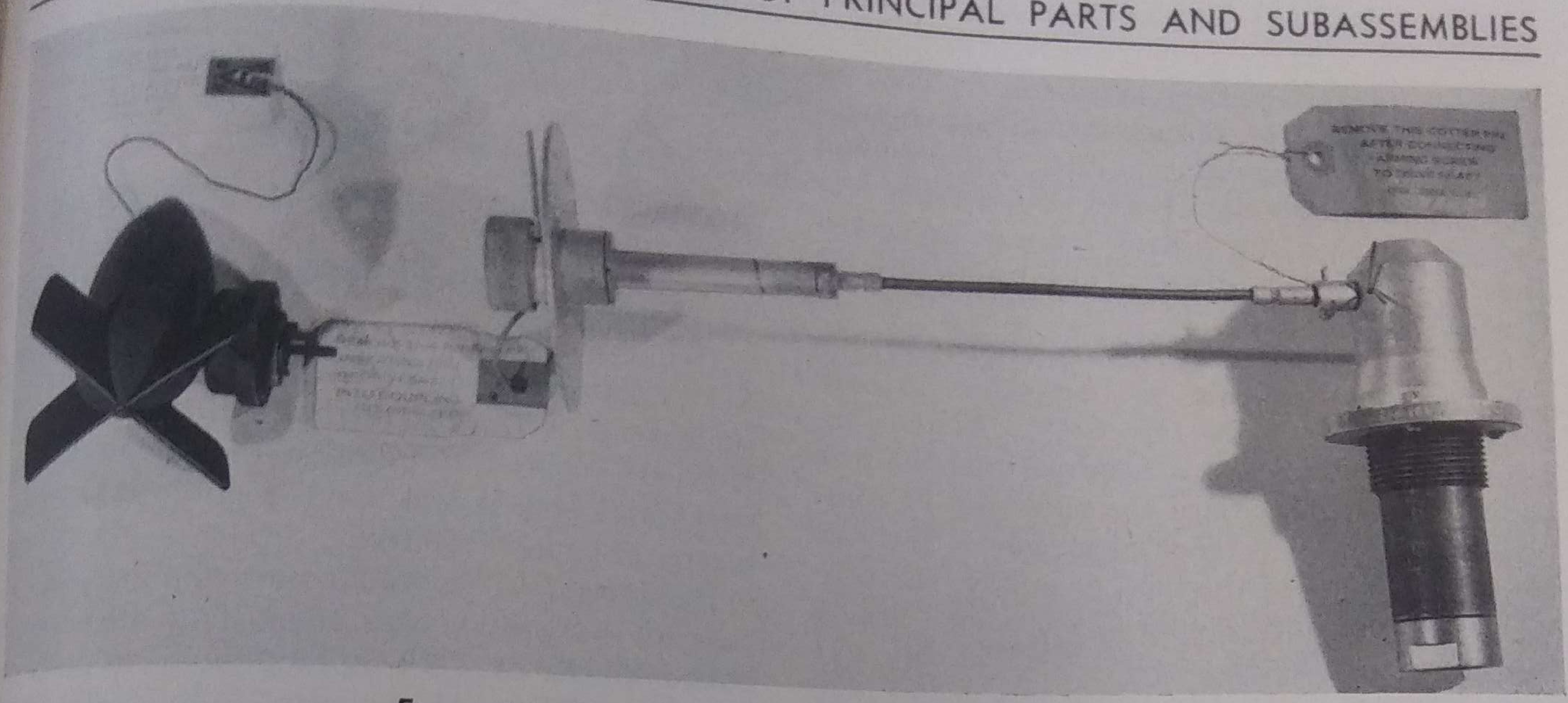

Figure 84—Bomb Fuze Mk 236 and Driving Unit.

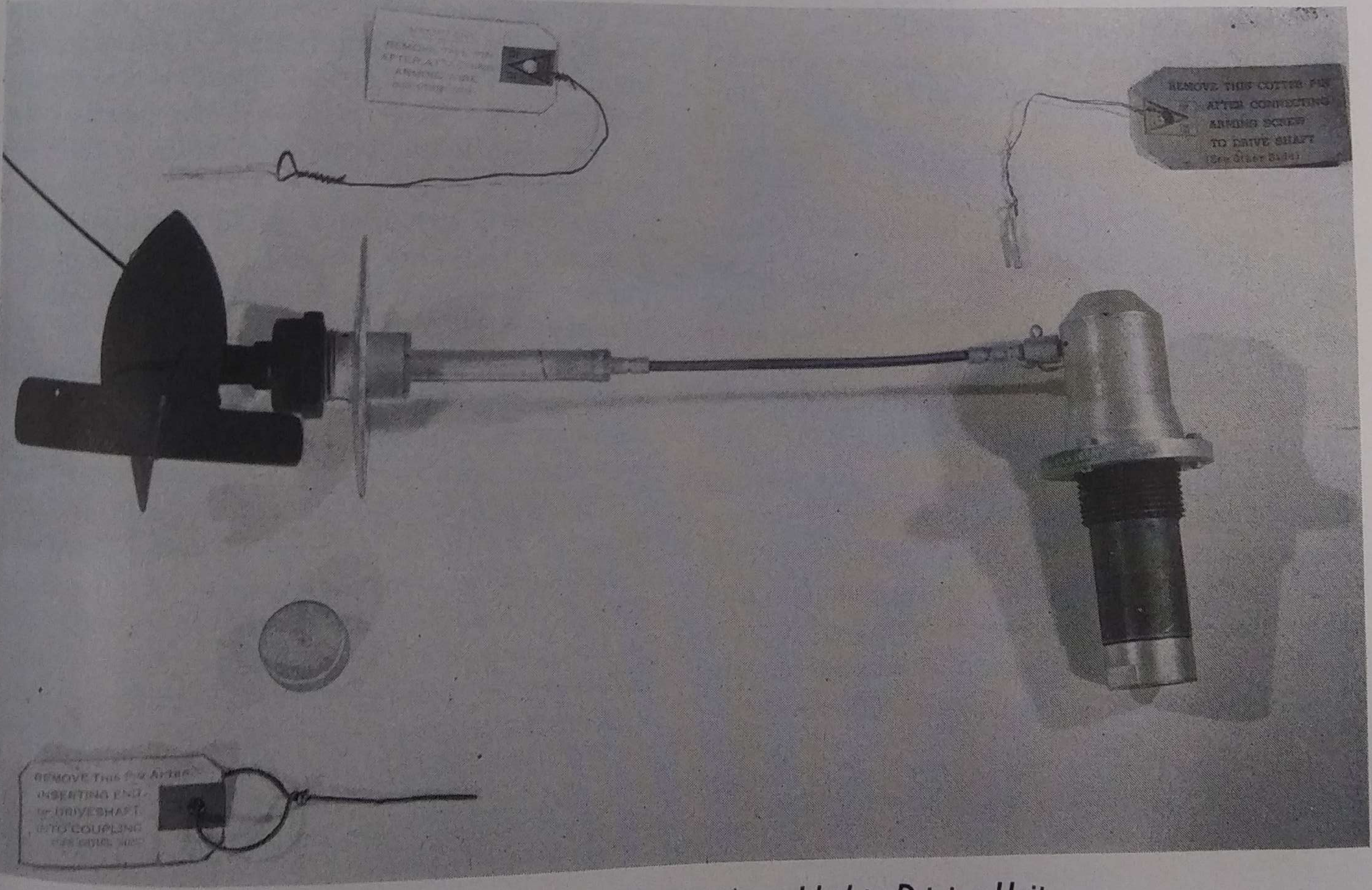

Figure 85—Bomb Fuze Mk 236 Assembled to Driving Unit.

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SAFETY FEATURES DURING SHIPMENT: The fuze is assembled in the unarmed condition and remains in that condition during shipping and stowage. During shipping and until the bomb is completely fuzed, the arming screw is prevented from rotating by a cotter pin which passes through the fuze body.

ARMED OR PARTIALLY ARMED FUZE: In the unarmed condition, the arming screw extends completely through the fuze body. As the fuze arms, the arming screw is removed from the fuze body. When fully armed the screw will be completely removed. If the arming screw is not visible on both sides of the fuze, or is even partially withdrawn, the fuze should be considered armed and handled with the greatest possible care. If examination of a partially armed fuze shows that the hole in the striker is aligned with the hole in the fuze body, the arming screw may be replaced but the fuze should still be rejected for service use. Procedure for installation of the tail fuze may be found in chapter 4, section 1 a, page 86.

SERVICING: No servicing of this fuze is authorized or recommended. It is not recommended that any lubricating be done to the driving unit or the arming screw since this varies the arming distance. Disassembly of this fuze is not authorized.

PACKING AND MARKING OF SPECIAL BOMB FUZES MK 235 AND MK 236: The Bomb Fuzes Mk 235 and Mk 236, complete with their driving units, are hermetically sealed in a metal container in order to prevent corrosion or damage in shipping. The flexible shaft comes attached to the driving vane which is packed with SWOD (Air Stabilizer) Mk 13. Four fuze cans are packed in metal packing crates 16½-inches x 25⅝-inches. The packing crate for the fuzes weighs 86 pounds loaded. Each fuze is stamped with the mark and mod number, lot number, manufacturer's initials, year of manufacture, and inspector's initials. Each fuze container is stencilled as follows:

Lot number.
Name of manufacturer.
Contract number.
Weight net ______ pounds.

Year of manufacture.
Inspector's initials.

Weight gross ______ pounds.

11. DEMOLITION OUTFIT MK 122 MOD 0

Demolition Outfit Mk 122 was a device used on the SWOD Mk 9 Mod 0 to protect the security of the weapon. This feature has now been removed. However a brief description of the demolition outfit and how it was used is given below as a matter of general interest.

Destruction of the radar unit contained in the nose of the weapon was effected by 10 one-half pound blocks of TNT appropriately located on the unit. These blocks were individually connected to a junction box by a prima cord (PTN) which was fired by the squib in the junction box of the destructor.

In operation, the inertia switch was armed by an arming vane of the same type as provided for the arming of the bomb fuzes. When armed and upon impact, the electrical circuit was completed from the servo battery through the inertia switch to the squib in the junction box, firing the prima cord and TNT blocks.

The inertia switch was tested to withstand 100 *g* in drop test when unarmed. When armed, an impact of approximately 11 *g* would close the switch.

The arming wire from the bomb rack to the arming vane of the inertia switch was wired to the bomb rack so that the SWOD Mk 9 would not be released with the demolition outfit unarmed.

The junction box of the demolition outfit provided for the attachment of Firing Device Mk 3 modified for a maximum delay of 60 minutes. This device was attached to the BAT by a member of the plane crew in event of a forced landing involving the possibility of the equipment falling into enemy hands.

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Chapter 4

ASSEMBLY, CHECKOUT, AND HANDLING

1. ASSEMBLY AND CHECKOUT

a. SWOD Mk 9 Mod 0 (BAT–0)

All units to be assembled for SWOD Mk 9 Mod 0 are shipped in crates marked List No. 1, List No. 2, and List No. 10. For information as to what each list contains, see Appendix A, section **d**. The check sheets used along with the assembly and testing are shown in Appendix D.

The recommended procedure for assembly is given below.

(1) Remove the fuselage, wings, and stabilizers from crate List No. 10.

(2) Remove all cowlings.

(3) Follow the modification procedure given in chapter 3, section 1 (c), page 23.

(4) Place the fuselage in its normal position on trestles (two wooden horses are satisfactory; see Figure 86–A). **Note:** SWOD (Servo) Mk 4 Mod 4 (Flight Control Servo PU–146/DPN–2) comes already installed in some air stabilizers. If not, it must be installed according to No. 7, col. 2.

(5) Install power supply.

(a) Remove power supply and inverter from crate List No. 1.

(b) Remove suspension bar which is strapped to the frame of the air stabilizer and mount on the air frame. Fasten at the rear with bolt furnished.

(c) Swing suspension bar above servo.

(d) Lift SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP–284/DPN–1) into place, being sure that the large power plug is to the front as shown in Figure 86–B.

(e) Align the holes of the power supply brackets with holes in the steel frame of the fuselage.

(f) Both the cowlings and power supply will later be secured with the same four bolts previously removed when cowlings were removed.

(6) Install inverter.

(a) On the plywood shelf in front of the power supply there are provided four holes for mounting the inverter.

(b) Place the inverter on the shelf with plugs on the left. Align the holes of the inverter with those in the shelf. See Figure 87–A.

(c) Secure inverter to the shelf with four bolts provided.

(7) Install Servo Mk 4 Mod 4 (Flight Control Servo PU–145/DPN–1) if not already installed.

(a) Remove the six bolts on the right side (looking from rear) of the air frame and remove the wooden patch which covers a portion of the slot through which the servo arm extends.

(b) Holding the servo at an angle, slide the left servo arm through the slot on the left side, then the right servo arm through the slot on the right side.

(c) Secure the servo to the air frame by fastening it to the supports at the rear of the servo with the six bolts furnished.

(d) Replace the patch over the slot on the right side.

(8) Remove the dummy bulkhead on the front of the fuselage. The purpose of this dummy bulkhead is to keep the fuselage from warping during stowage. (Figure 87–B).

(9) Remove main bulkhead from crate List No. 1 or No. 2. This bulkhead contains SWOD (Gyro Panel) Mk 6 already installed. Dismount gyro panel from wooden bulkhead and remove inertia switch, then assemble. The inertia switch and harness are parts of the destructor assembly which is no longer used.

(10) Check gyro panel on bulkhead by procedure given in chapter 3, section 7b, page 51.

(11) Secure the four bulkhead attachment bolts used to hold the bulkhead in the crate to the bulkhead mounting brackets of the fuselage.

(12) Install gyro panel bulkhead in fuselage where dummy bulkhead was removed (Figure 88–A).

(13) Install SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN–1).

(a) Remove the radar nose from crate List No. 1.

(b) Remove the wooden shipping bracket from the back of radar nose (Figure 88–B).

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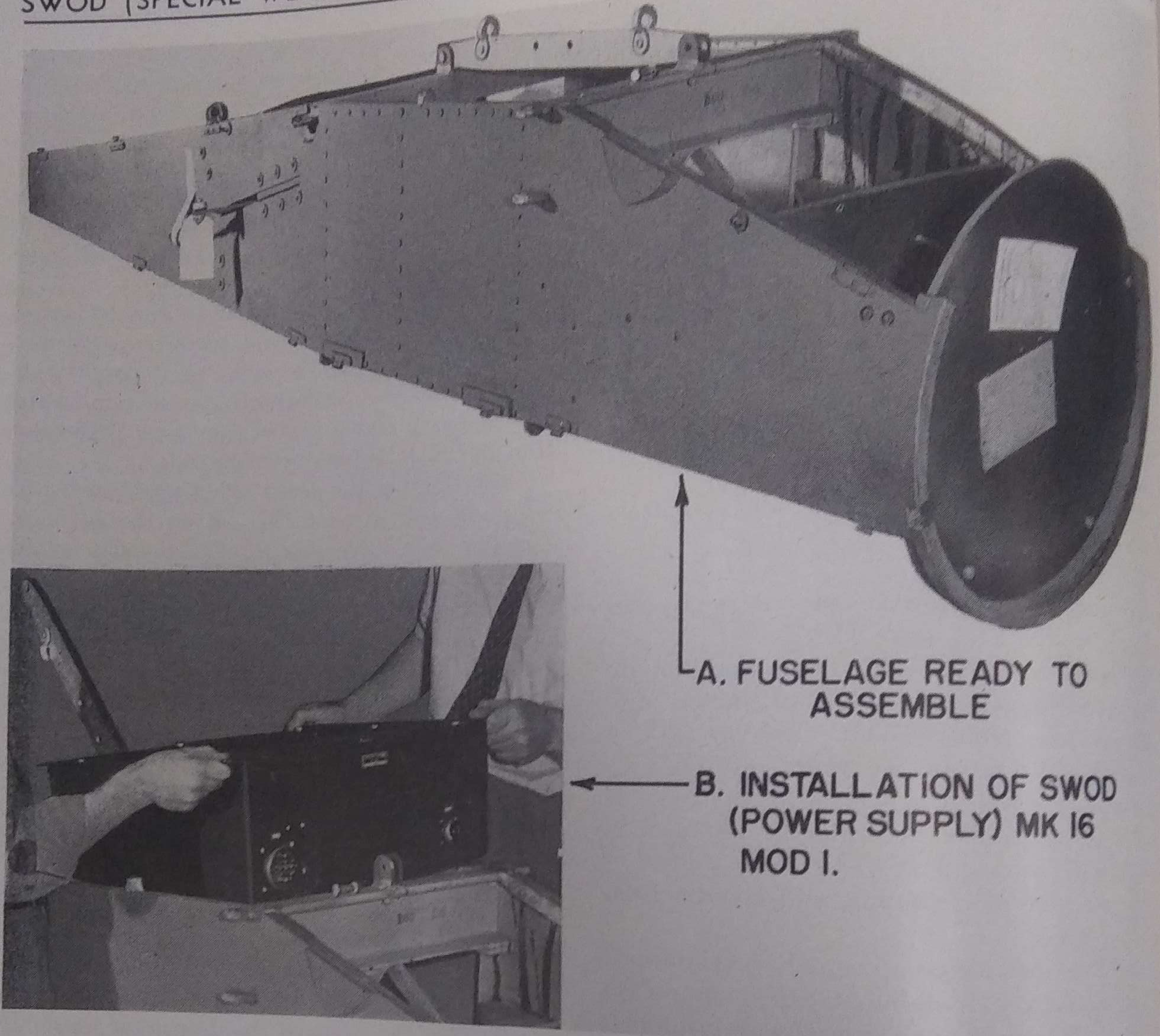
A. FUSELAGE READY TO ASSEMBLE
B. INSTALLATION OF SWOD (POWER SUPPLY) MK 16 MOD I.

Figures 86A and 86B.

(c) Unfasten and remove the nose cover.

(d) A complete visual inspection should be made at this time.

(e) Mount the nose forward of the gyro panel bulkhead using the same four bolts that secure the gyro panel bulkhead (Figure 89–A).

(f) Tighten the elastic stop nuts securely.

(g) Assembly check.

(14) Attach wings to the fuselage (Figure 89–B).

(a) List either wing into place.

(b) Lift the tip of the wing slightly so that the supporting pin may be easily driven into place.

(c) Secure with cotter keys.

(d) Follow the same procedure for the oth wing.

(15) Connect eleven control rods (Figure 90–A

(a) Loosen the elevon control rods by re moving the tape that holds them to the elevons

(b) Place the elevon control rod in positi so that the hole in one end corresponds with th hole in the servo arm.

(c) Place the bolt downward through th Fafnir bearing then through the servo arm an secure with caster nut and cotter key.

(d) Fasten the other end of the elevon con trol rod in the same manner but with the bolt hea

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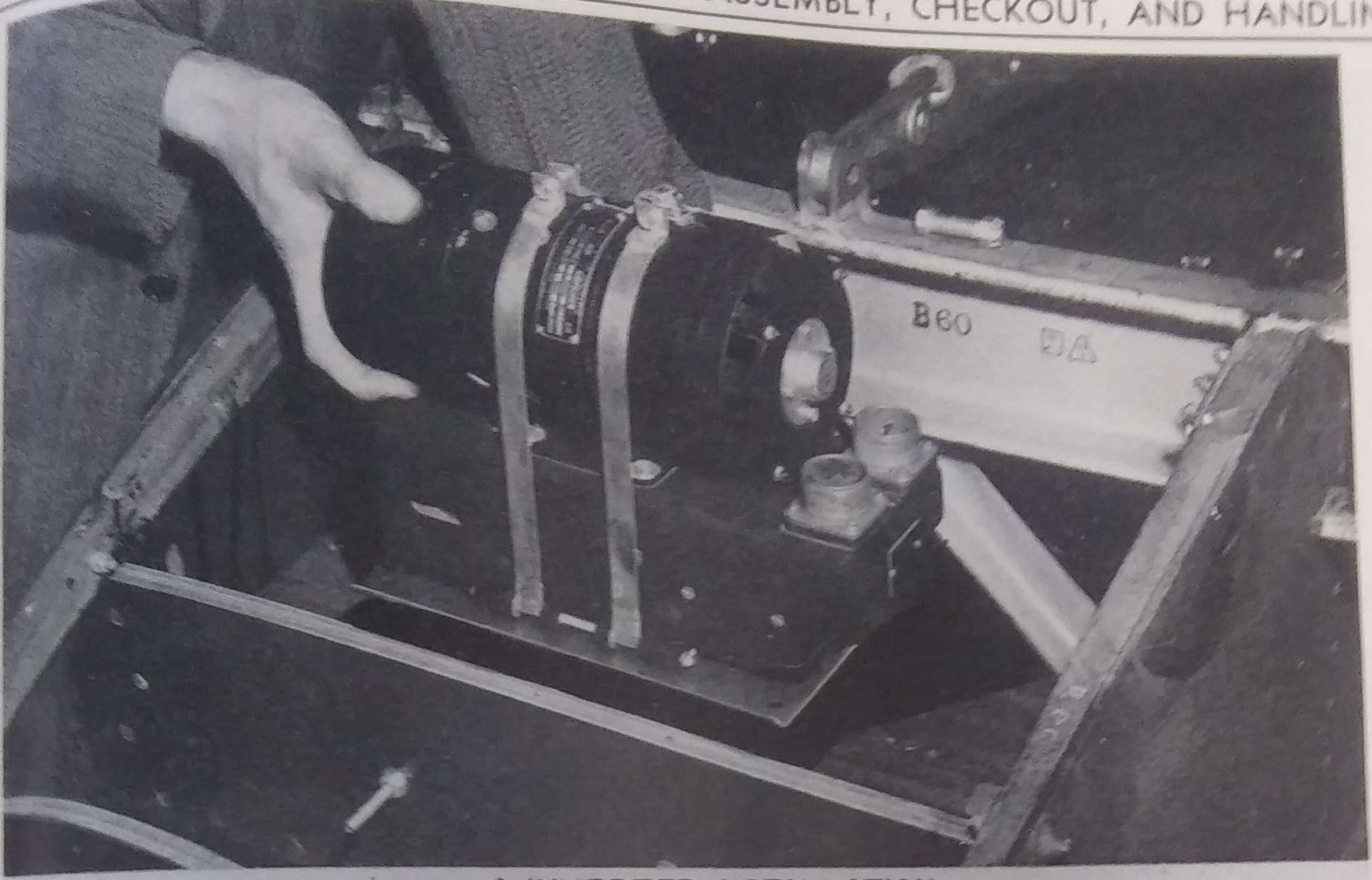
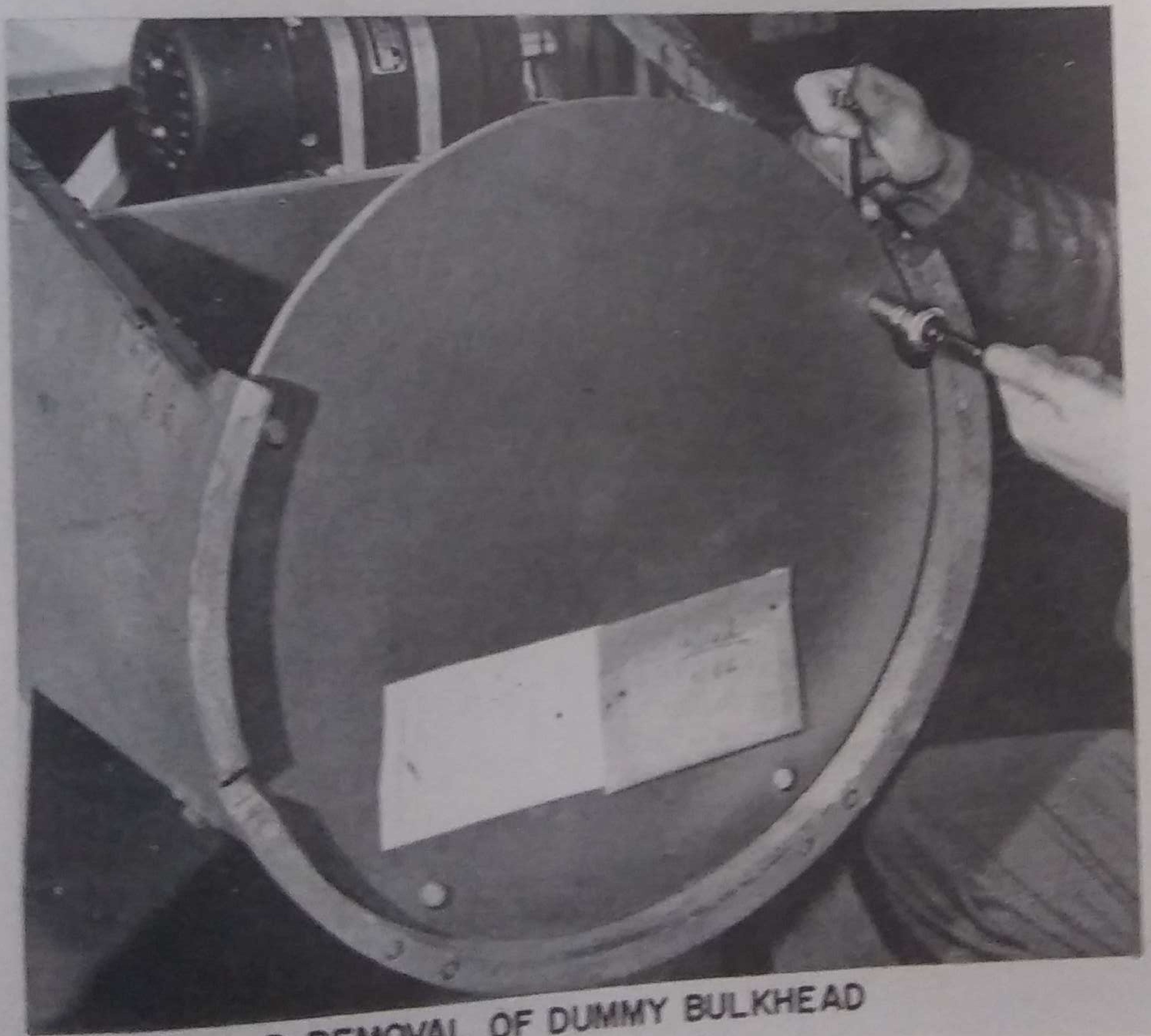


A. INVERTER INSTALLATION



B. REMOVAL OF DUMMY BULKHEAD

Figures 87A and 87B.

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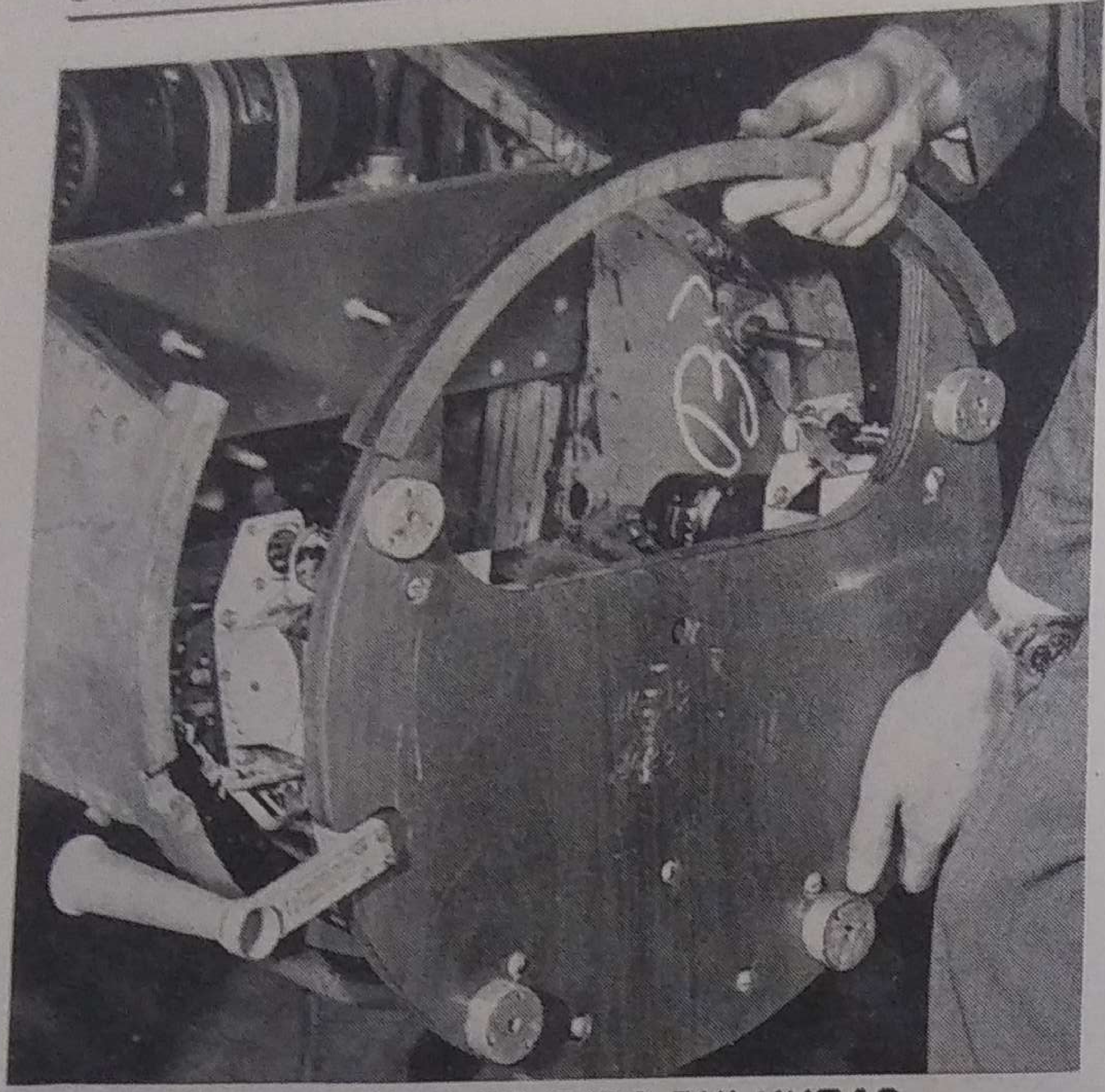

A. INSTALLATION OF GYRO BULKHEAD
B. REMOVAL OF SHIPPING CRATE FROM RADAR

Figures 88A and 88B.

toward the fuselage. Secure with nut and cotter key. **Note:** The elevon control rods are pre-set and with the servo arms in neutral the elevons will be in neutral.

(e) Check the elevons for neutral according to instructions in chapter 3, section 1f, page 27.

(16) Attach rear horizontal stabilizer to fuselage (Figure 90–B).

(a) Remove the horizontal king pin found in brackets beneath and at the rear of the fuselage.

(b) Put the horizontal stabilizer into place; reinsert the king pin into bracket and secure with cotter key.

(c) Insert $\frac{7}{16}$-inch bolt found in bracket at the rear of the fuselage, through the horizontal stabilizer.

(d) Tighten and secure with cotter key.

(17) Secure the vertical stabilizers to the horizontal stabilizer by joining hinge parts with pins; then lift vertical stabilizers and secure by placing pins through the hinge-type brackets (Figure 91–A).

(18) Check the decalage according to instructions given in chapter 3, section 1f, page 27.

(19) Set the Spinner Angle according to instructions in chapter 3, section 1f, page 27.

(20) Install batteries.

(a) Remove batteries from Crate List No. 1. **Note:** The batteries are shipped dry-charged and contain no electrolyte. These batteries should be previously readied for service according to instructions found in chapter 3, section 5e, page 34.

(b) Place batteries in battery box at the rear of the fuselage and orientate them as shown in Figure 91–B.

(c) Secure with wooden bracket.

(d) Connect all battery cables as illustrated in Figure 92.

(21) Connect all other cables not previously connected.

Note: The final check should be done at this time. Follow check sheet shown in Appendix D.

(22) Replace top cowlings.

(23) Install bomb nose fuze in bomb (Figure 93–A). **Note:** Handling of fuzes and arming couplings should only be done by personnel trained in servicing these devices.

(a) Lift bomb with hoist and place on bomb dolly so that the single lug is on the right side.

(b) Remove nose shipping plugs from the bomb. Clean the fuze seat liner and threads if necessary.

(c) Remove fuze from shipping container and

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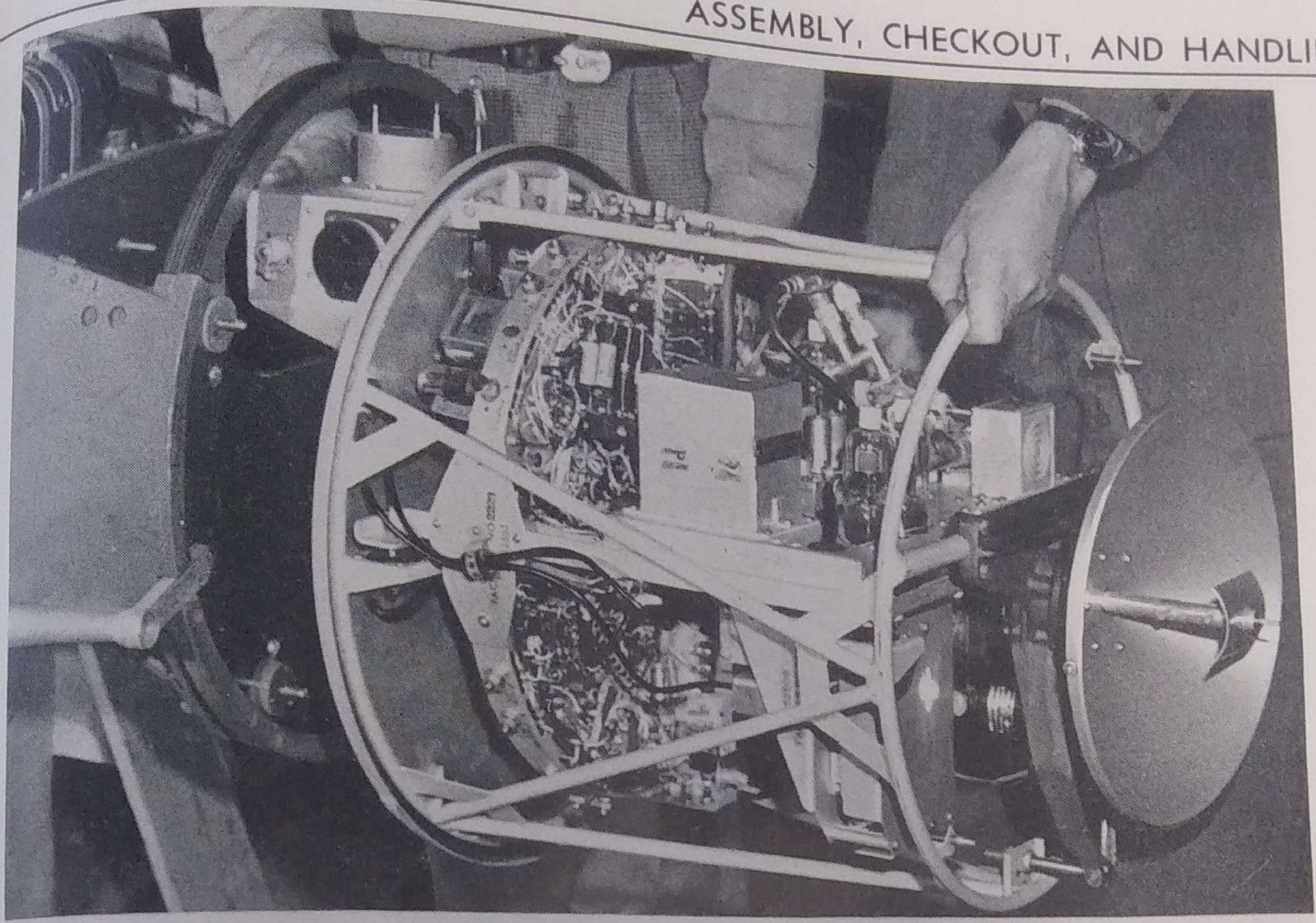
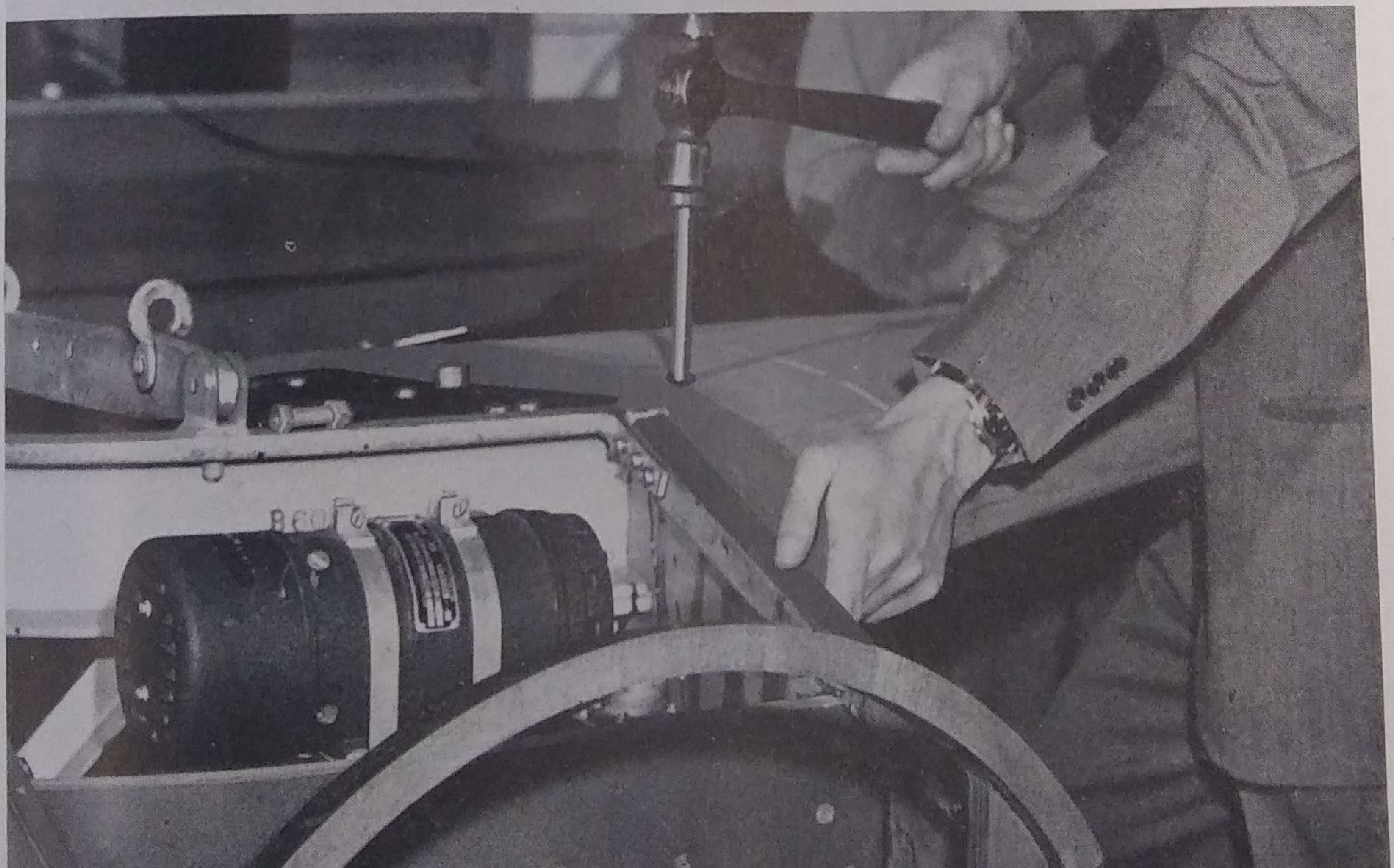


A. INSTALLATION OF RADAR

B. ATTACHING WINGS



Figures 89A and 89B.

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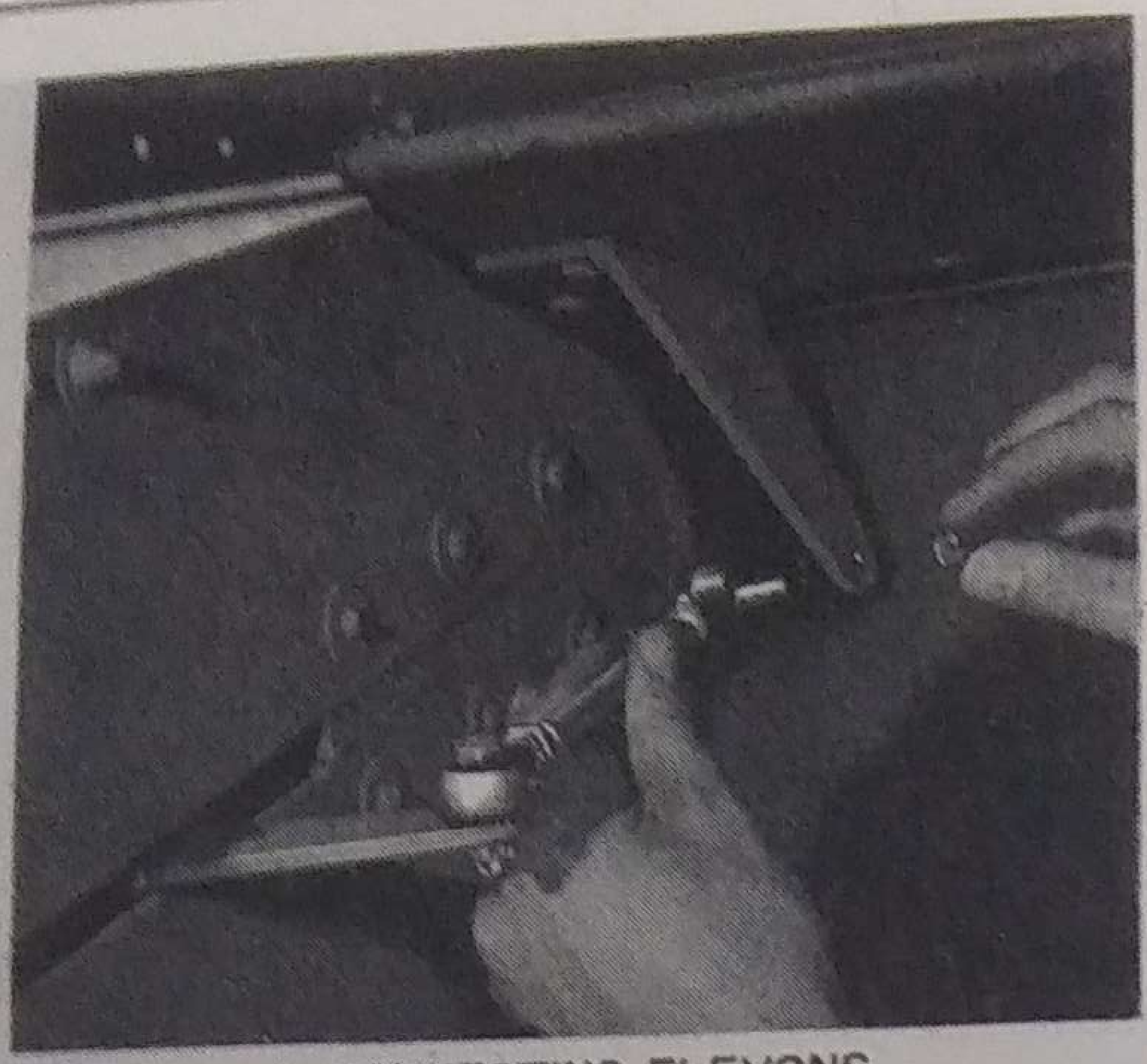
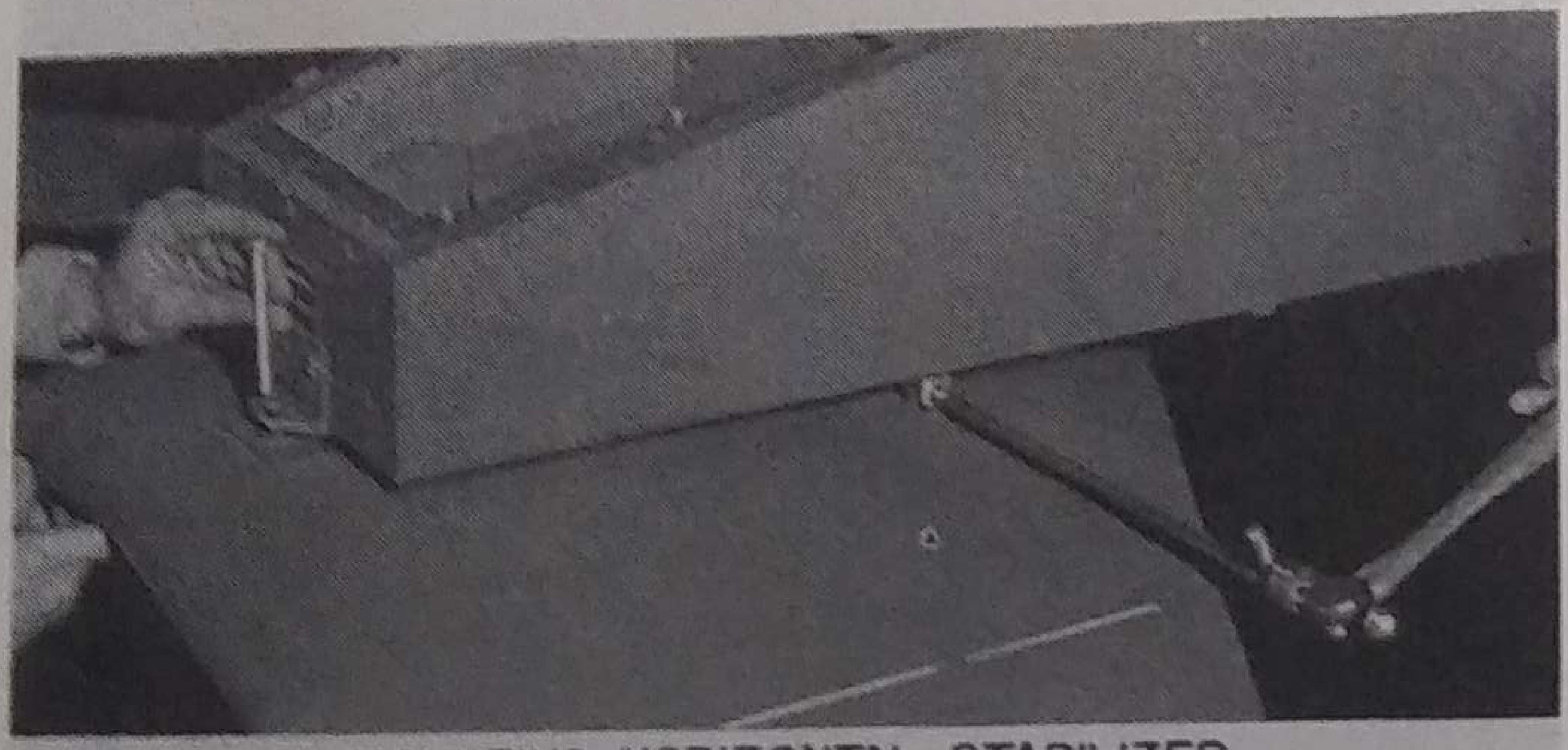


A. CONNECTING ELEVONS



B. MOUNTING HORIZONTAL STABILIZER

Figures 90A and 90B.

inspect outward appearance for any apparent damage. Reject any damaged fuzes.

(d) Screw the fuze into the bomb until the fuze is firmly seated against the nose of the bomb. (With some fuzes a large steel washer may be found. This is a spacing ring and should be placed between the fuze body shoulder and the bomb.)

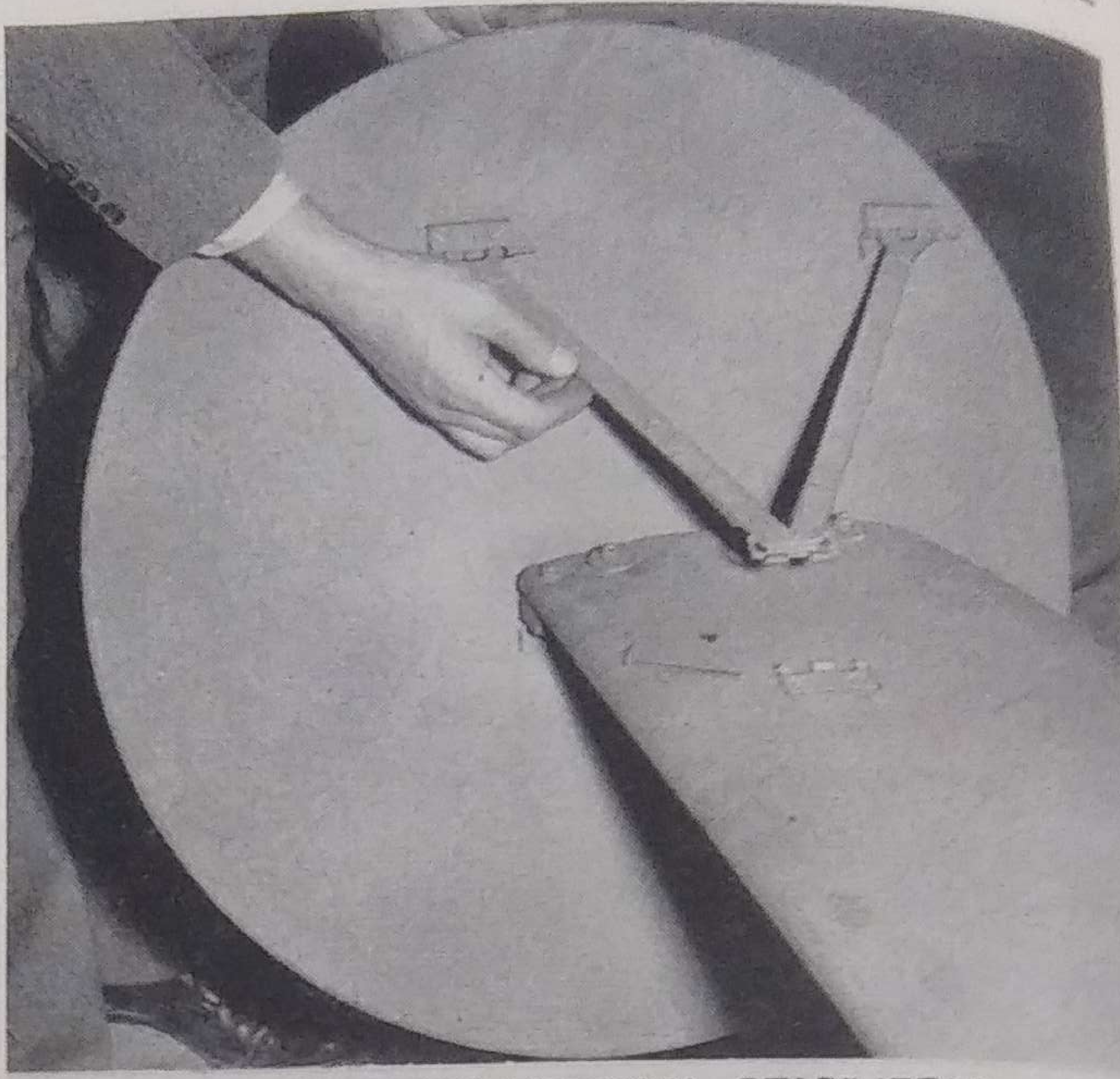
(24) Install tail bomb fuze (Figure 93–B).

(a) Remove the shipping plug from the adapter booster. Clean the fuze seat liner and threads if necessary.

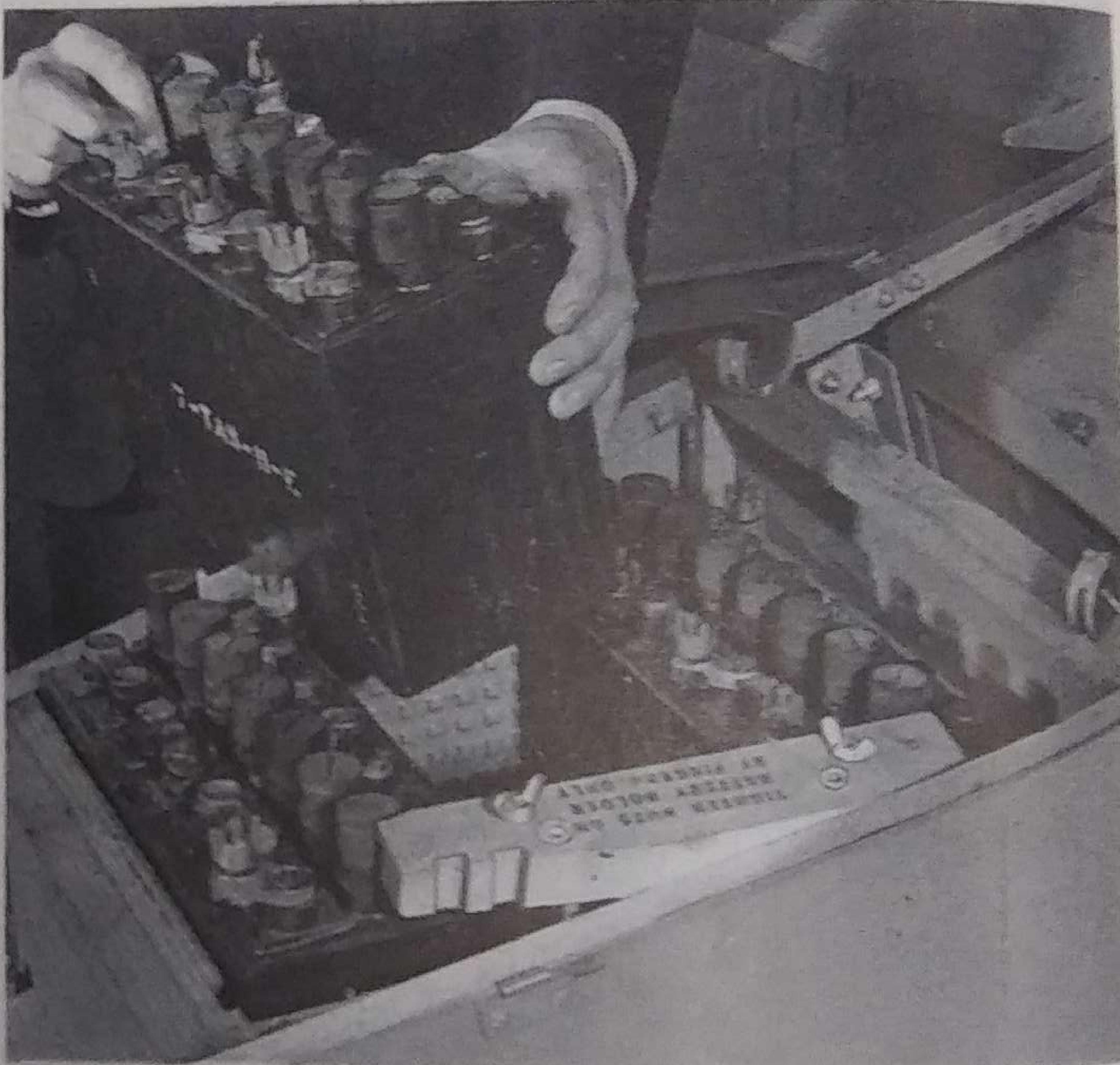
(b) Tighten the adapter booster set screw as tightly as possible to prevent any relative motion between the fuze adapter and bomb.

(c) Remove the fuze from the shipping container and inspect outward appearances for any apparent damage. Reject any damaged fuzes.

(d) Back out the three set screws until they do not extend inside the fuze flange. Screw the fuze into the bomb until the fuze seats against the bottom of the adapter booster. Unscrew fuze only sufficiently to allow the arming screw to point in a direction which is directly opposite the single suspension lug on the bomb. Tighten set screws until fuze is firmly attached to bomb.



A. ERECTING VERTICAL STABILIZERS



B. INSERTING BATTERIES

Figures 91A and 91B.

NOTE: While installing the nose and tail bomb fuzes the following checks should be made: Check fuze seat liner and clean if necessary. Inspect fuzes for battered threads or other external evidence of unsuitability.

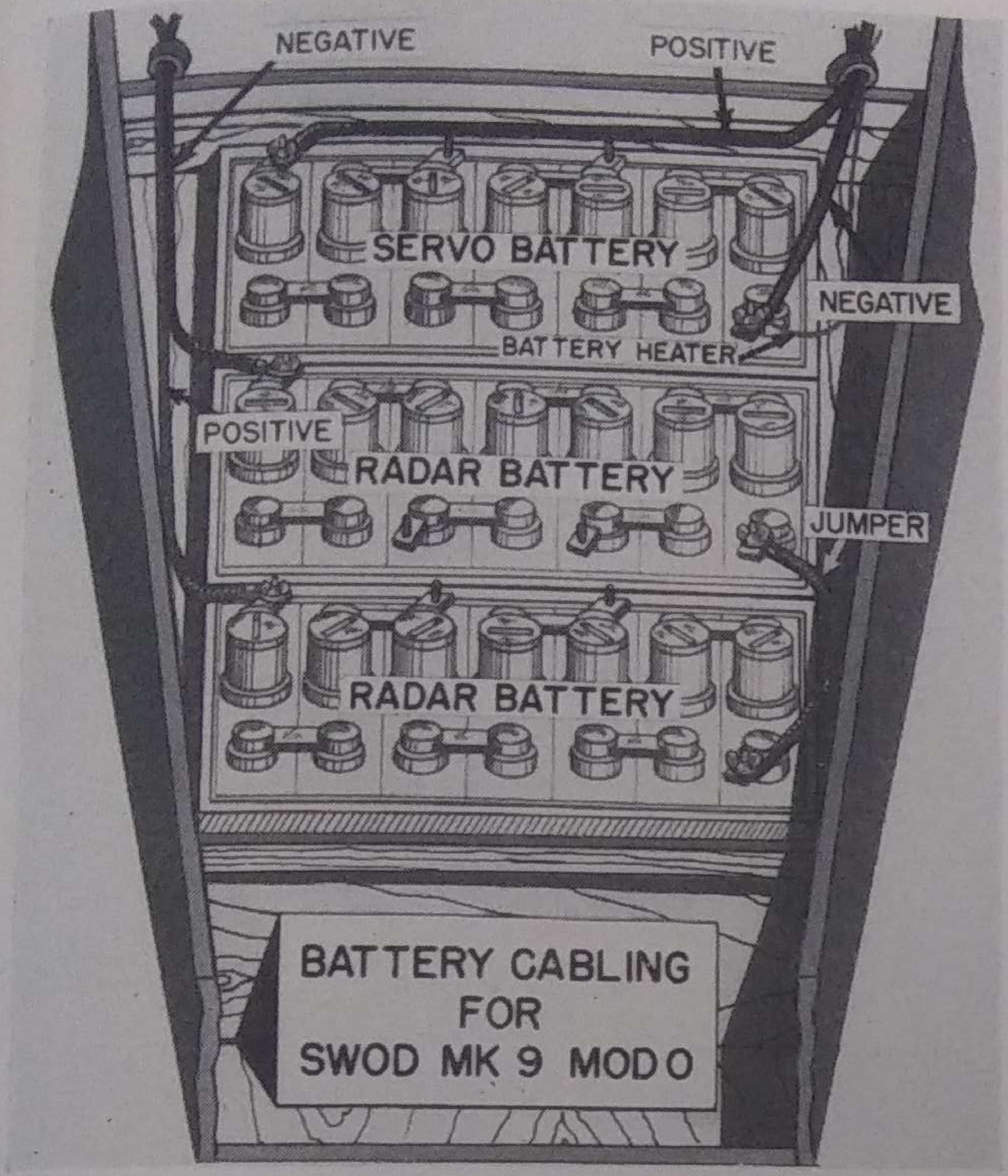


Figure 92—Battery Cabling for SWOD Mk 9 Mod 0.

(25) Install bomb in air stabilizer.

(a) Lift the fuselage with hoist, being careful that the stabilizer which is nose heavy does not tip forward and strike the deck.

(b) Place the fuselage over the bomb which was previously placed on a dolly.

(c) Check spacer screws in the angles of the fuselage frame. The forward screws should extend $\frac{3}{16}$ inch from the front angles and $\frac{7}{8}$ inch from the rear angle.

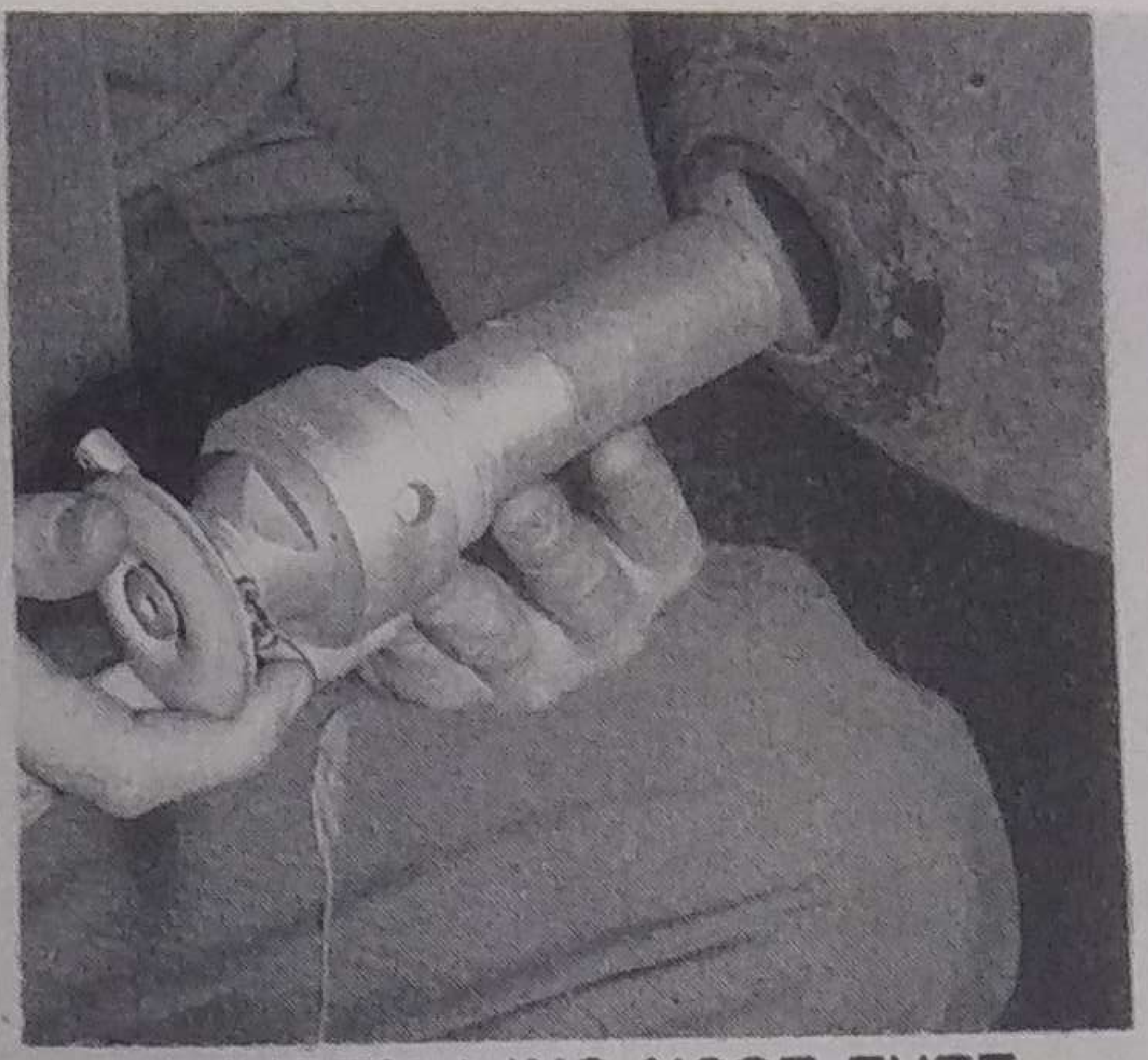
(d) Adjust the bomb braces on the fuselage to fit on the bomb lugs and secure (Figure 94).

(e) Attach and secure the bomb straps (Figures 95 and 96–A).

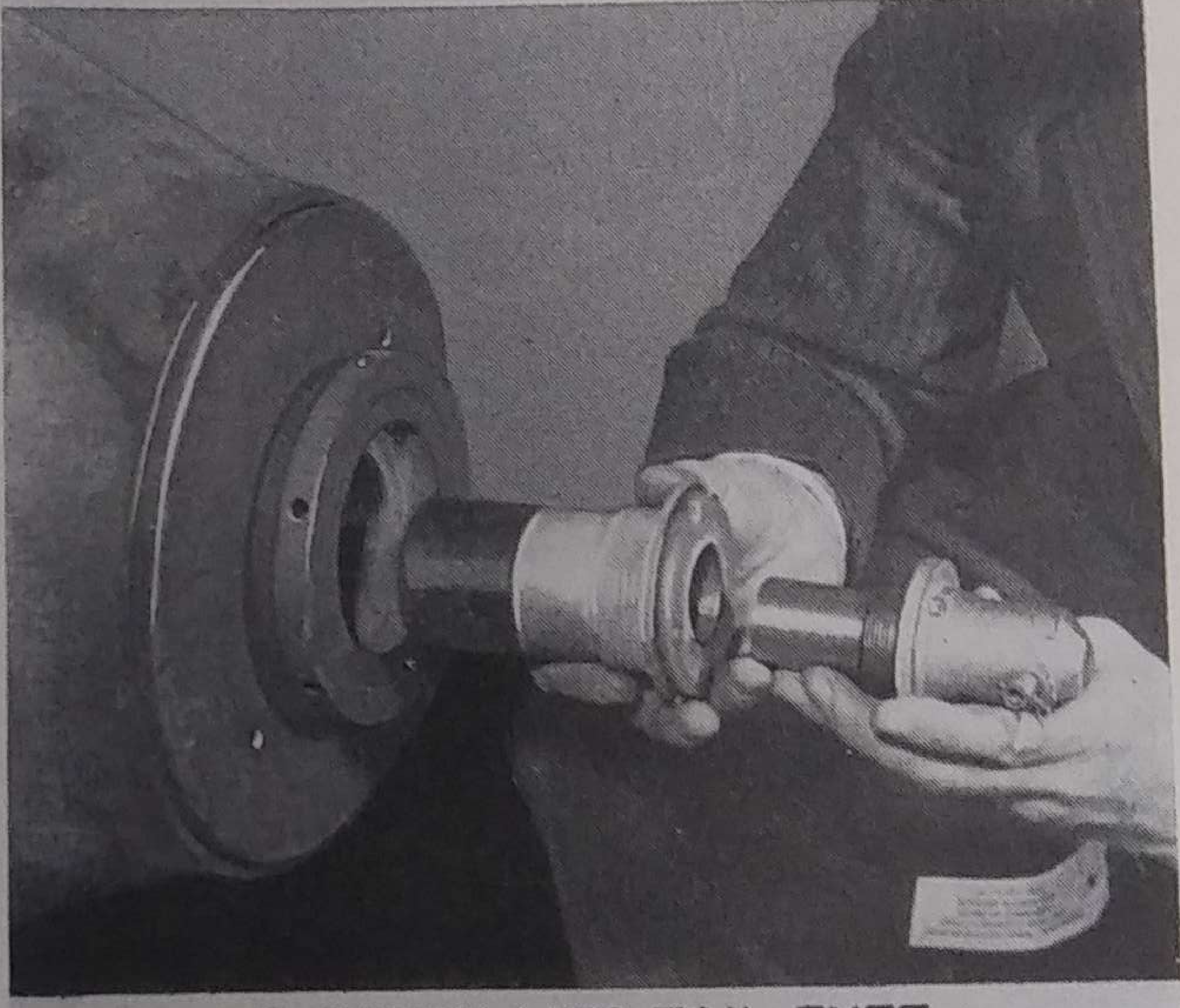
(26) Attach arming screw of nose fuze to flexible shaft by means of cotter pin provided and remove safety cotter pin from the arming screw. See Figure 97. Refer to Figures 80, 81, and 82 for further information.

(27) Attach arming vane for nose fuze to the forward and left side of the cowling (Figure 96–B).

(a) Remove cover from coupling and safety wire.



A. INSTALLING NOSE FUZE



B. INSTALLING TAIL FUZE

Figures 93A and 93B.

(b) Attach arming vane.

(c) Tighten the connecting collar wrench-tight, using a $1\frac{1}{4}$-inch open end wrench.

(d) Tighten set screws on collar. A $\frac{3}{16}$-inch or smaller screwdriver is required.

(28) Attach arming vane for tail fuze as in No. 27 above.

(29) Attach arming screw of tail fuze to flexible shaft with cotter pin provided and remove the safety cotter pin from the arming screw. Refer to Figures 83, 84, and 85 for further information.

WARNING: FAILURE TO TIGHTEN AND LOCK THE ARMING VANE PROPERLY MAY RESULT IN ITS

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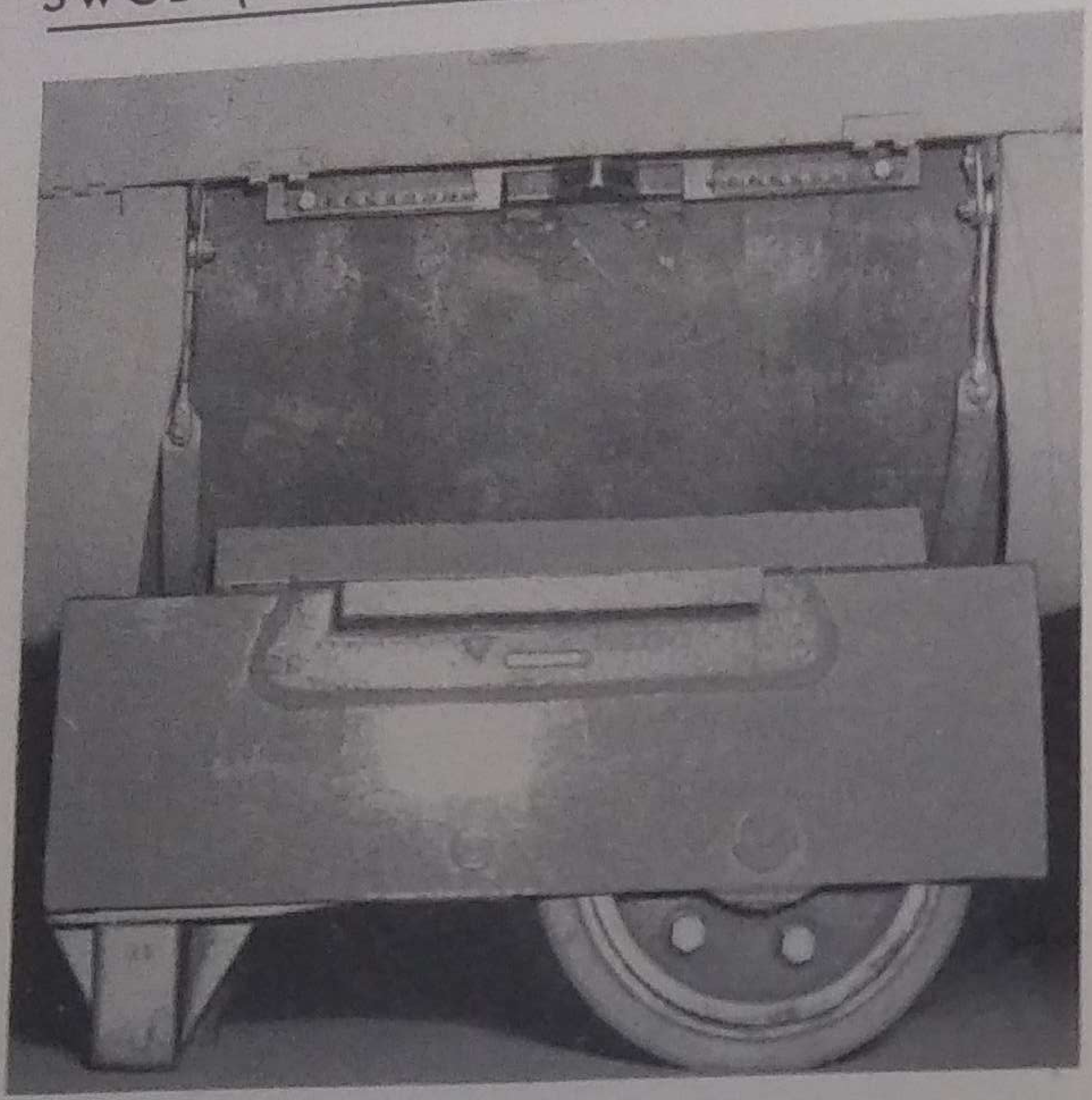


Figure 94—Bomb Brace Fitted on Single Bomb Lug.

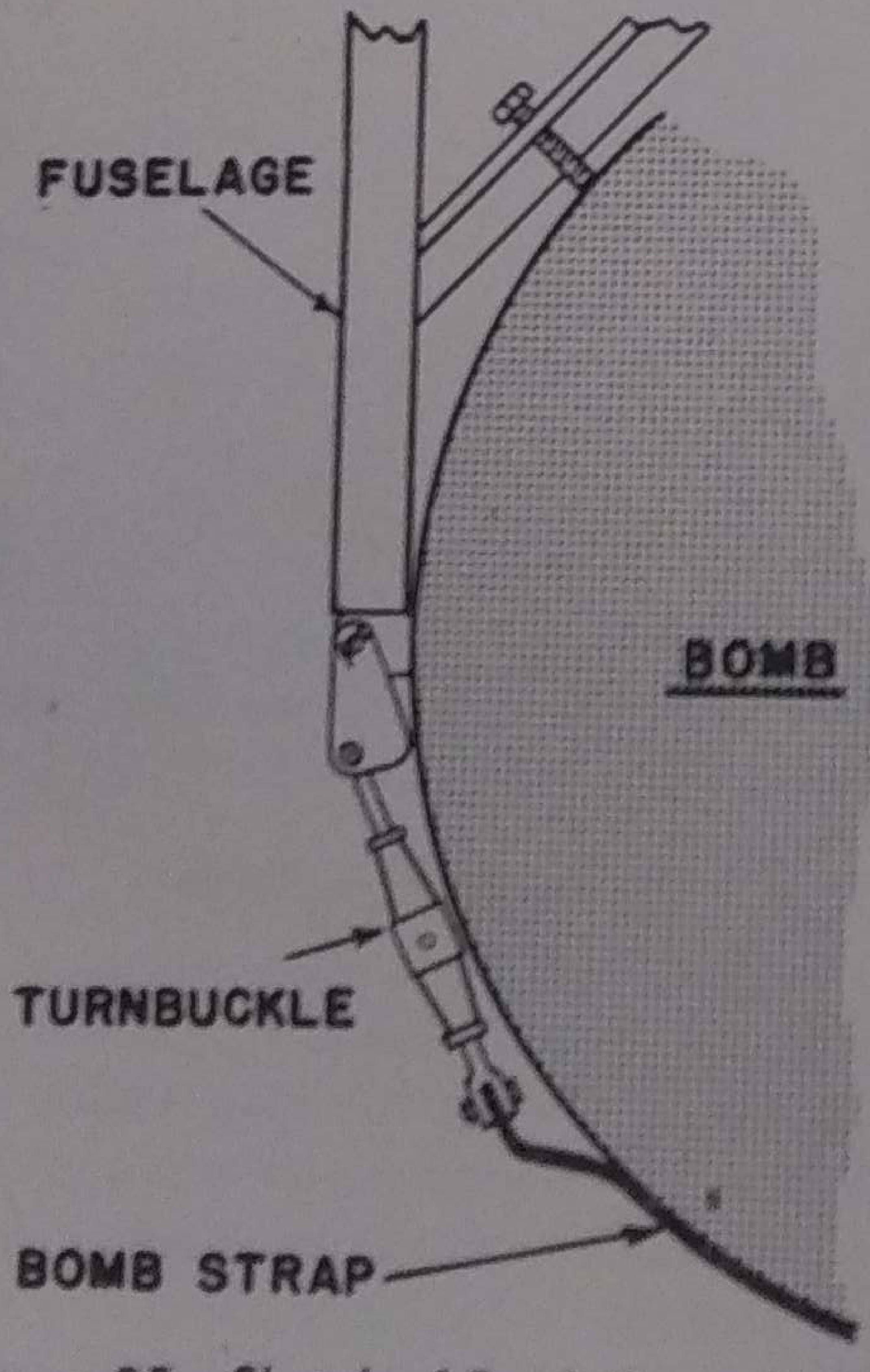
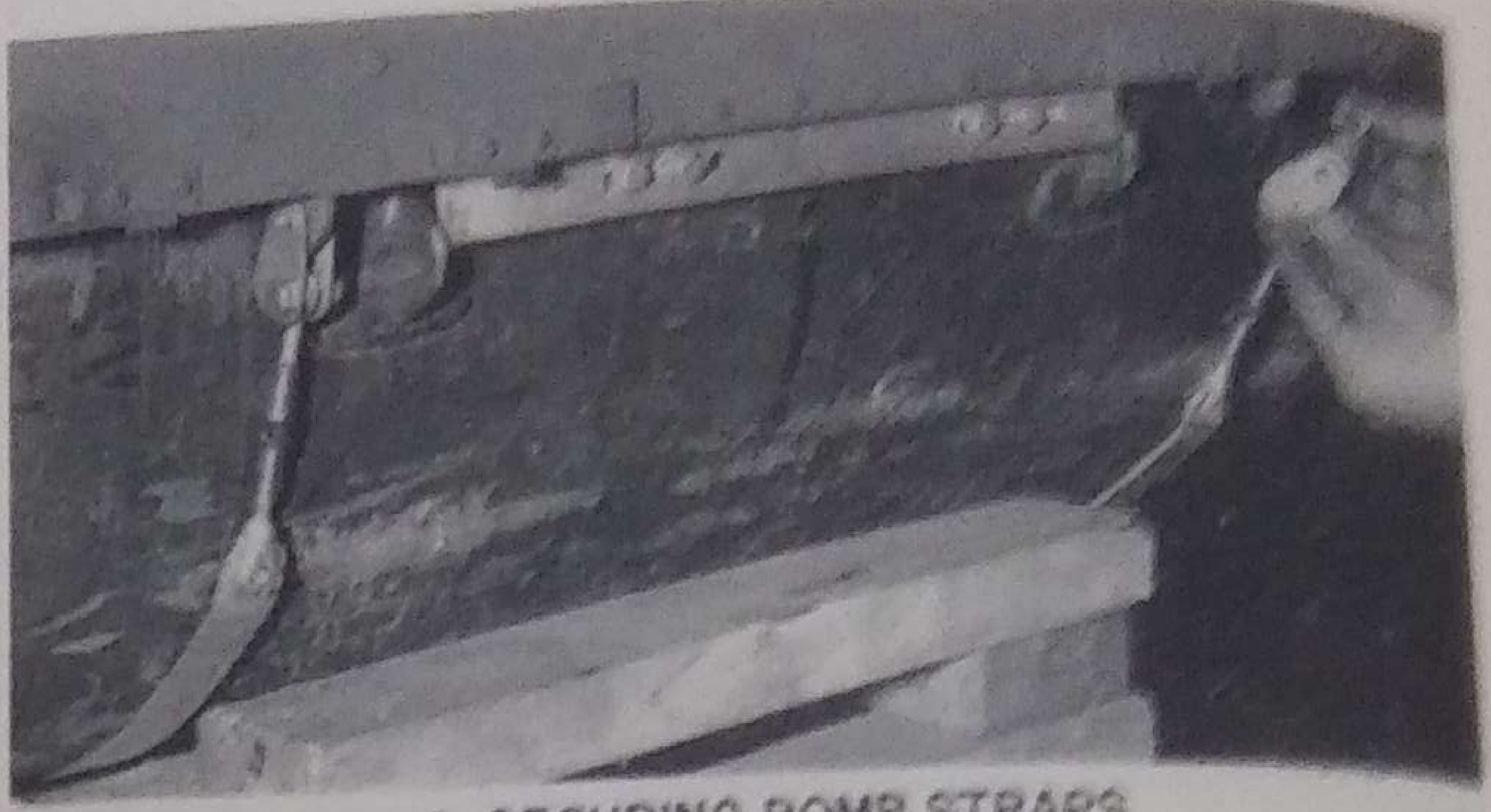
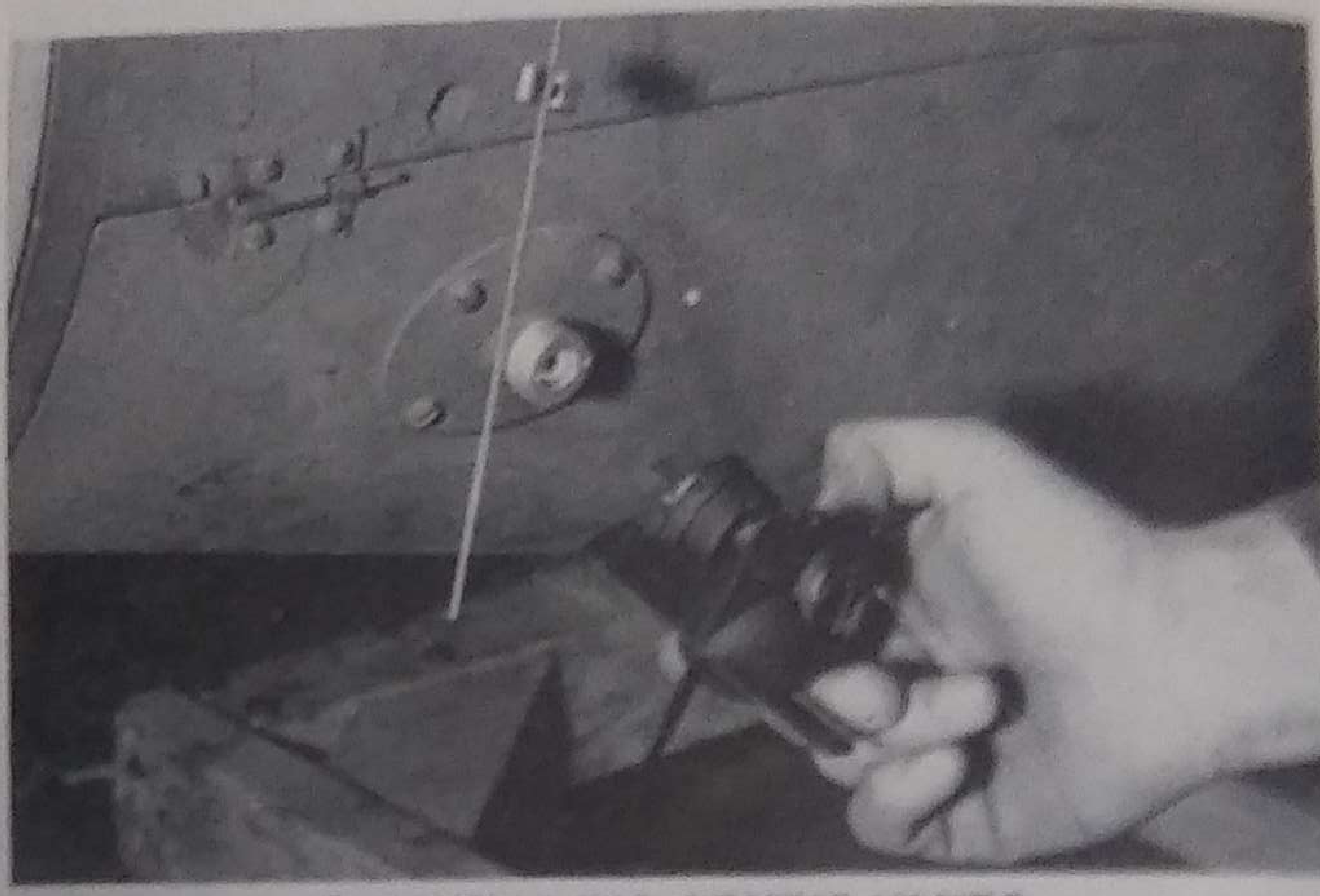


Figure 95—Sketch of Bomb Strap Shackle.

LOSS IN FLIGHT AND SUBSEQUENT ARMING OF THE BOMB BY NORMAL VIBRATIONS.



A. SECURING BOMB STRAPS



B. INSTALLING ARMING VANES

Figures 96A and 96B.

NOTE: After the SWOD Mk 9 is hung to aircraft the arming wire must be put through the vertical hole in the external arming vanes for both the nose and tail fuzes so that the spring loaded safety pin is locked in place, thus locking the air vanes and flexible shaft. This operation must be done *before* the safety cotter pin in the arming vane is removed. Refer to Figures 84 and 85. A Fahnestock safety clip is used to retain the arming wire in the air vane. It is recommended that about three inches of arming wire be left protruding from the arming mechanism. Care should be taken to see that the arming wire is not bent and that it is free of burrs.

(30) Recheck the decalage.

(31) Raise complete unit with power hoist using a bolt and clevis through the rear hole of the suspension bar.

(32) Attach all cowlings.

(33) Balance complete unit according to instructions given in chapter 3, section 11, pp. 31–2.

The SWOD Mk 9 Mod 0 is now ready for hanging.

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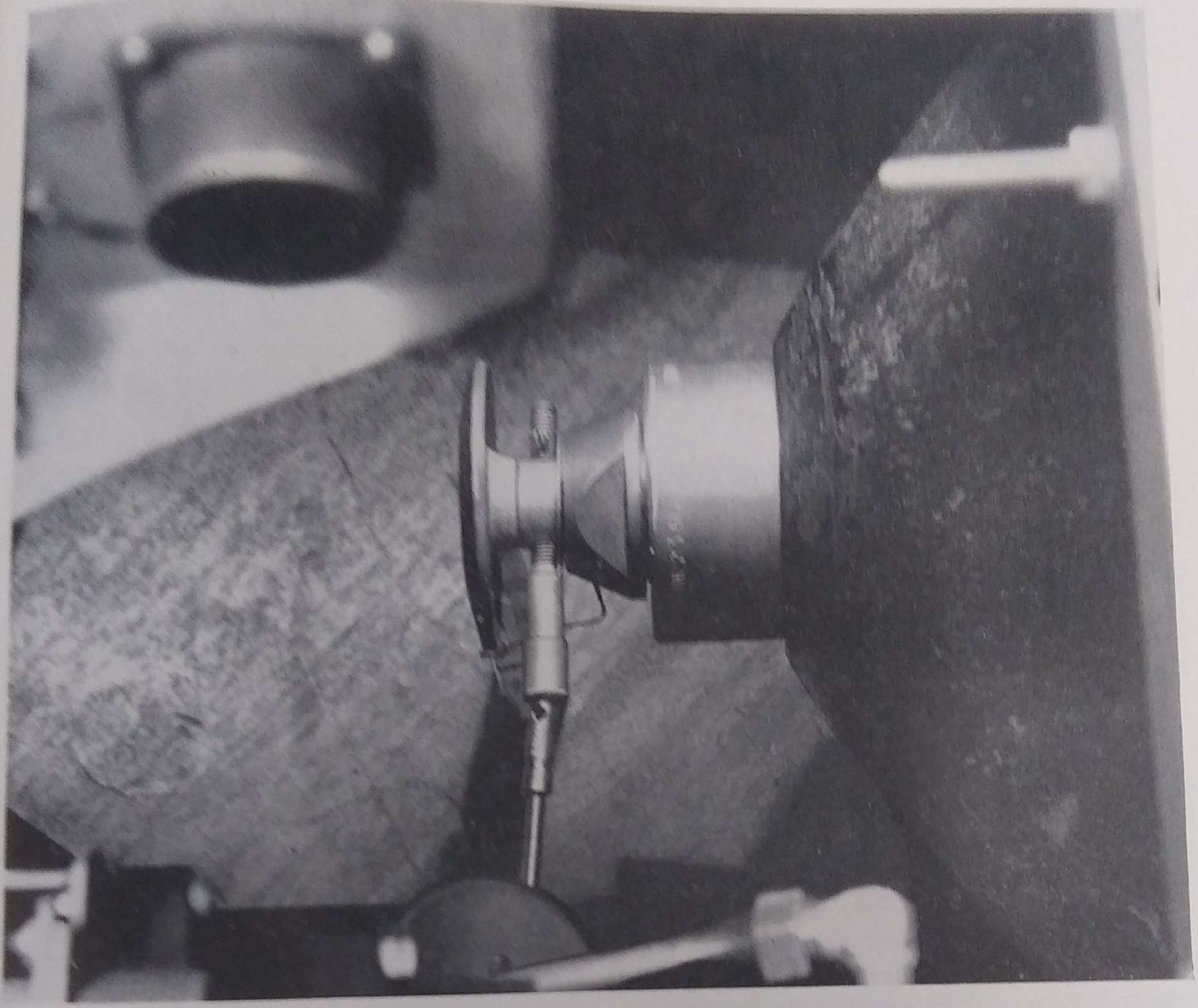

Figure 97—Nose Fuze Arming Screw and Flexible Drive Shaft.

b. SWOD Mk 9 Mod 1 (BAT–1)

The instructions for assembling SWOD Mk 9 Mod 1 are supplementary to the instructions for the assembly of SWOD Mk 9 Mod 0, the additional directions being necessary because of:

(1) The modification of the air stabilizer.

(2) The installation of new equipment.

(3) The modification of other equipment.

After the above mentioned modifications have been accomplished, assembly of the SWOD Mk 9 Mod 1 is then possible. These modification procedures are given in the Appendix B.

It is suggested that the following procedure be used for assembly.

(1) Place air stabilizer on trestles.

(2) Remove cover of SWOD (Control System) Mk 18 Mod 1.

(3) Install the SWOD (Control System) Mk 18 Mod 1 (PU–146/DPN–2).

(a) Mount rear control system mounting brackets so that screws are about two turns short of tight. Mount front brackets with one screw in lower front hole with screw loose enough to rotate brackets forward freely.

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(b) Turn control system output arms to glide position until the forked output arms are within the frame. Do not freeze linkage against frame.

NOTE: The output arms are moved to position by turning the slotted shaft clockwise on top of right clutch (pitch) mechanism. If turning right clutch mechanism does not completely draw output arms inside, a small rotation of the left clutch (roll) mechanism will aid.

(c) Lower control system slowly into fuselage by means of a mechanical or electric hoist.

NOTE: Do not allow control system to come to rest on relays on lower rear or gyro assembly on the front of the control system. Further, do not allow output arms to swing out with possible subsequent damage.

(d) With control system held in location rotate front mounting brackets to proper positions and bolt loosely.

(e) Start slotted head cap screws with lock washers which secure control system to brackets. Use a screw-holding screw driver to aid in *starting* rear screws. Tighten with socket wrench. After tightening the foregoing screws tighten bolts securing brackets to fuselage.

(f) Adjust control system to neutral by manually operating pitch and roll clutches. Neutral position is obtained by *Carefully* lining up scribed lines on shafts and bushings on under side of control system. There are two shafts for each, the roll and pitch, which must be lined up to neutral.

(g) Remove starboard (painted green) shoulder screw from linkage. Pull output arms out through slots in fuselage. With a pair of pliers pinch the welded, slotted block on the arm which serves as a nut so that the slot is closed slightly. Place shoulder screws in the elbows. The distorted slot acts as a means of locking. The screws are dissimilar; therefore the color aids in their proper location.

(4) Attach wings (same as for Mod 0).

(5) Connect elevon control rods.

(a) Place right elevon in position with neutral jig. Slide jig over the wing until the screw heads are held firmly on the plywood skin just before the elevon, and the forward V notch of the jig is centered on the leading edge of the wing. Moving the rear V notch against the trailing edge of the elevon, the neutral position is obtained.

(b) With control system and elevon in neutral, install and adjust push rod to proper length. Adjust rod end bearings so that free rotation will exist even at full extreme movements of elevon. Tighten lock nuts. Check for sufficient threads by putting pin into inspection hole of bearing on the push rod. If the hole is closed, sufficient threads are mated.

(c) Repeat foregoing for left elevon.

(d) Turn clutch shafts to obtain extreme movements of each elevon. At each extreme recheck freedom of rod and bearings. After check apply glytol to threads.

(e) Place short hose section and hose clamp on nipple on lower front of gyro so that thumb screw points upward. Tighten securely.

(6) Install SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP–285/DPN–2) as follows:

(a) Route cable from directional control amplifier modification kit under inverter shelf and through front and rear triangle sections on left side of fuselage center sections. Connect cable connector to connector on left front of control system. Also route a long hose section from fuselage modification kit under inverter shelf and through front and rear triangle sections on right side of fuselage center section. Fasten open end to hose nipple on top to gyro, using provided hose clamp as means of securing. Cable clamp is to be mounted with thumb screw close to gyro.

(b) Connect Y cable from power supply modification kit to bottom of power supply. Install power supply into fuselage, guiding cable through triangle section on right rear of metal center section. Connect connector of cable to right front connector on control system. Allow heavy leads and lead with fuse holder to drape under control system. Connect short hose length from gyro to fitting on power supply. Secure well. Fasten power supply in normal manner.

(7) Install inverter (same as for Mod 0).

(8) Install batteries and cables as follows:

(a) Route heavy leads from power supply, supply leads of control system and the negative heater lead through conduit elbow. Be sure power supply leads will not be chafed by moving parts of control system.

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(b) Assemble heater lead fuse holder with five ampere fuse installed and clamp fuse holder into previously located clamp.

(c) Install batteries and connect leads as per Figure 98. Hold position control system lead away from forward battery with cable clamp on battery compartment bulkhead. Tighten all battery terminal bolts.

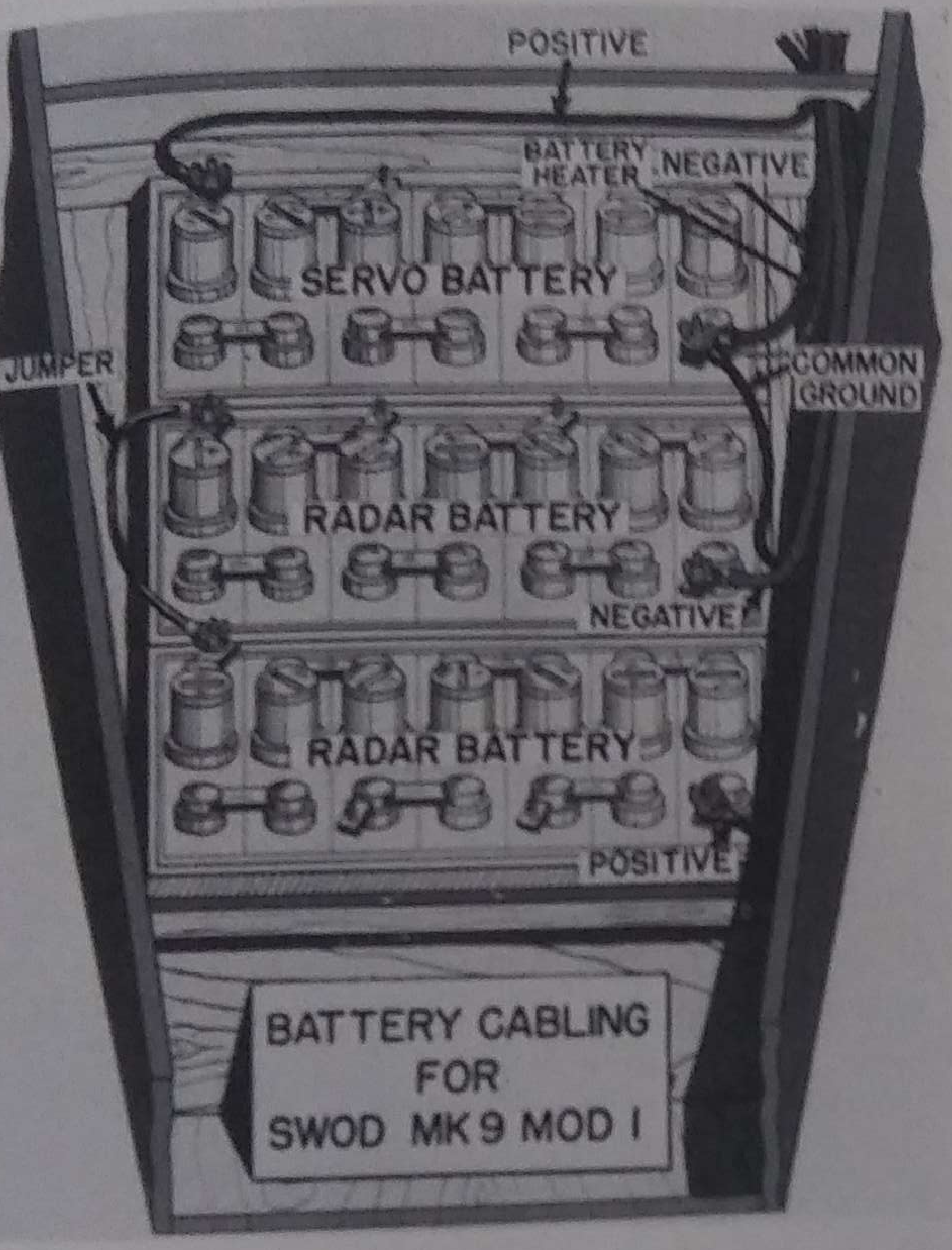

Figure 98—Battery Cabling for SWOD Mk 9 Mod 1.

(9) Assemble SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2) to bulkhead assembly and mount in fuselage as follows:

(a) Obtain mounting studs for SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2). These may be found in the radar cable carton.

(b) Mount directional control amplifier to rear of bulkhead assembly with provided 10/32 x ⅜-inch slotted hex head screws and flat washers.

(c) Install mounting studs into fuselage bulkhead mounting brackets. Mount bulkhead assembly on studs.

(d) Connect spinner cable to connector on upper left hand side of radar bulkhead. Mount radar to bulkhead studs, threading cable through hole in wood bulkhead. Secure with stop nuts.

(e) Connect hose section from gyro to T fitting on right Venturi.

(f) Connect remaining cables and ends of cables to proper connectors on radar junction box and directional control amplifier.

(10) Install rear stabilizer as follows:

(a) Mount rear stabilizer in normal manner. Check decalage using procedure given in chapter 3, pp. 28–30. If more or less than 2° 15′ adjust as follows: If decalage is too great, decrease with shim washers previously attached to vertical fin angles. If decalage is too small, increase by filing top surface of decalage spacers on mounting bracket.

NOTE: For each 0.004 inch that the horizontal stabilizer is raised or lowered at the rear attachment bolt, with respect to the fuselage, the decalage is increased or decreased by 1 minute.

(11) Set the radar spinner angle following instructions in chapter 3, pp. 30–31.

(12) The final preflight check should be done at this time.

(13) Install nose fuze as for the Mod 0.

(14) Install tail fuze as for Mod 0.

(15) Install bomb in air stabilizer.

(a) Remove corrugated bomb brace on left side of fuselage. Unlatch bomb cinch straps on side.

(b) Place bomb with fuzes installed on dolly so that bomb suspension lugs are on right side and in a horizontal position with respect to the bomb center.

(c) Hoist air stabilizer and lower on the bomb slowly noting the following: (*1*) Bottom of power supply should have small clearance from top of bomb; (*2*) Inverter shelf should be clear of bomb; (*3*) Lowest point on gyro should be about ⅜-inch above the bomb; (*4*) Right bomb brace extremities are between suspension lugs.

(d) With air stabilizer firmly seated on bomb, remount corrugated bar on left side with cutout section holding bomb lug.

(e) Fasten bomb straps and cinch to proper tightness. If clearance of any of the above is not adequate, hoist air stabilizer and adjust screws on bomb support angles of air stabilizer center section. Do not make too great adjustments. If

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adjustment is made properly, secure lock nuts on screws.

(16) Secure top cowlings in normal manner.

NOTE: If rear part of lower front cowling will not fit, it may be necessary to raise bomb by unscrewing adjustment screws slightly then recinching bomb. Clearance must be maintained. Lower center cowling may bind if hoisting lug on bomb is not well up in notch of bomb brace.

(17) Connect nose bomb fuze to arming vane. Follow procedure given for Mod 0.

CAUTION: HANDLING OF FUZES AND ARMING COUPLINGS SHOULD BE DONE ONLY BY PERSONNEL TRAINED IN SERVICING THESE DEVICES.

(18) Connect tail bomb fuze to arming vane. Follow procedure given for Mod 0. **Note:** The tail fuze of the Mod 1 must be connected from beneath the air frame.

(19) Recheck decalage.

(20) Raise complete unit with power hoist, using a bolt and clevis through the rear hole of the suspension bar.

(21) Attach all cowlings.

(22) Balance complete unit according to instructions.

2. HANDLING

a. Packing

The overseas shipping crates in which the equipment is packed are designed for ease of handling and to protect the equipment under conditions of high humidity. Critical units are placed in Butvar envelopes to give added protection against moisture and fungus damage.

The equipment should be completely checked when removed from the packing crates to locate and correct damage that may have occurred during shipment.

b. List of Handling Equipment

A list of bomb handling equipment which may be used in the final assembly and loading is given below:

(1) Bomb Truck Mk 2 Mod 2.
(2) Bomb Trailer Mk 2 Mod 2.
(3) Portable Bomb Hoists Mk 6.
(4) Bomb Hoist Yoke NAMU Dwg B-00460.
(5) Power Hoist.

c. Loading the SWOD Mk 9 Mod 0 or Mod 1 (BAT-0 or BAT-1)

The following procedure is recommended for use in loading the SWOD Mk 9 Mod 0 or Mod 1 on the PB4Y-2 aircraft.

(1) Check the bomb rack for security before hoisting the BAT to the wing.

(2) Test the bomb rack by locking and then electrically tripping it from within the aircraft. To test the release mechanism electrically follow these instructions:

(a) On the armament switch box in the aircraft, set the arming switch and selector switch to the port or starboard BAT whichever is to be hung first.

(b) Close the master switch (Aircraft battery ON).

(c) Throw the jettison switch.

(d) The rack should then be tripped.

NOTE: When the arm switch is OFF the arming lugs on the bomb rack are free and will let the arming wires to the bomb slip from the rack *without* arming the bomb. When the arm switch is ON the arming lugs are locked and will pull the arming wires from the arming vanes of the bomb when the BAT is released. This function *must* be checked. It can be done at the same time as the release function is checked. If the rack operates correctly continue the loading procedure.

(3) Attach the bomb hoist yoke to the suspension bar of the SWOD Mk 9 (Figure 99-A). This accessory is fitted at right angles to the suspension bar and is secured through the forward hole.

(4) The Bomb Hoists Mk 6 are bolted to wooden pads on the wing to protect the surface of the wing.

(5) Pass cables through wing chutes and attach to the hoisting yoke connected to the suspension bar of the missile. This divides the load between the two cables (Figure 99-B).

(6) One man should direct the hoisting operation from the ground to see that the missile is hoisted evenly (Figure 99-C).

(7) After hoisting into place, lock in the rack (Figure 99-D).

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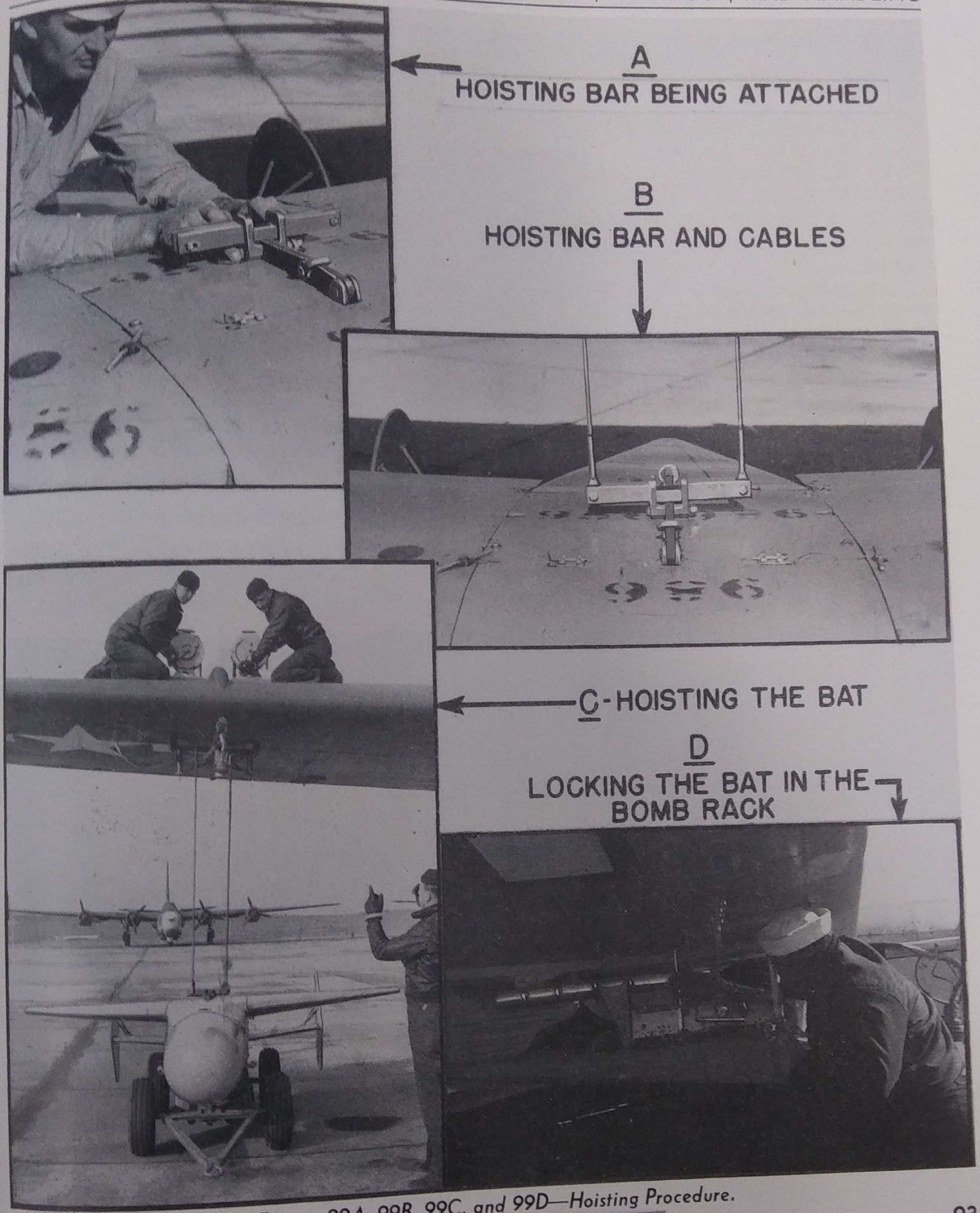

A
HOISTING BAR BEING ATTACHED

B
HOISTING BAR AND CABLES

C-HOISTING THE BAT

D
LOCKING THE BAT IN THE BOMB RACK

Figures 99A, 99B, 99C, and 99D—Hoisting Procedure.

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(8) Inspect trigger to see that it is properly engaged.

(9) Rock the missile to be sure it is hanging securely.

(10) Detach the hoisting cables.

(11) Adjust the safety wire and sway braces.

(12) Remove hoisting yoke.

(13) Attach the umbilical cable to the pull-away plug (Figure 99–D). Hammer it into place with a drift pin and hammer to make sure that it is seated.

(14) Attach the arming wire to the pull-away pin of the time delay switch. **Note:** At least *1 inch* of slack in the arming wire is necessary so that vibration and pull will not disengage the arming pin. Figure 100 shows the missile seated in the rack before the hoisting yoke has been removed or sway braces tightened but with umbilical and arming pin connected.

(15) Place all bottom fairings on and secure with cotter pins.

(16) Make sure that the nose and tail fuzes of the bomb are connected to the arming vanes. **Note:** Seat the arming vanes with a wrench and lock with the set screw. This is important as the vane might vibrate loose, causing the bomb to arm through vibration.

(17) Install arming wire in the arm lug of the rack.

(18) Thread the arming wire through the nose and tail arming vanes and secure with Fahnestock clips. Figure 101 shows the missile after the fairings and arming wires have been secured.

(19) Remove safety pins from arming vanes.

(20) Check vanes to make sure they cannot rotate.

The SWOD Mk 9 is now ready for its preflight check.

WARNING: SWAY BRACE PINS MUST ALWAYS BE SAFETY-WIRED PRIOR TO FLIGHT WHETHER OR NOT A MISSILE IS BEING CARRIED. FAILURE TO SAFETY-WIRE THE SWAY BRACE PINS ON AN UNLOADED RACK WILL RESULT IN THEIR LOSS DURING FLIGHT.

d. Alternate Loading Procedure

At the Naval Aviation Ordnance Test Station, Chincoteague, Va., a new type of bomb truck shown in Figure 102 was designed for simplifying

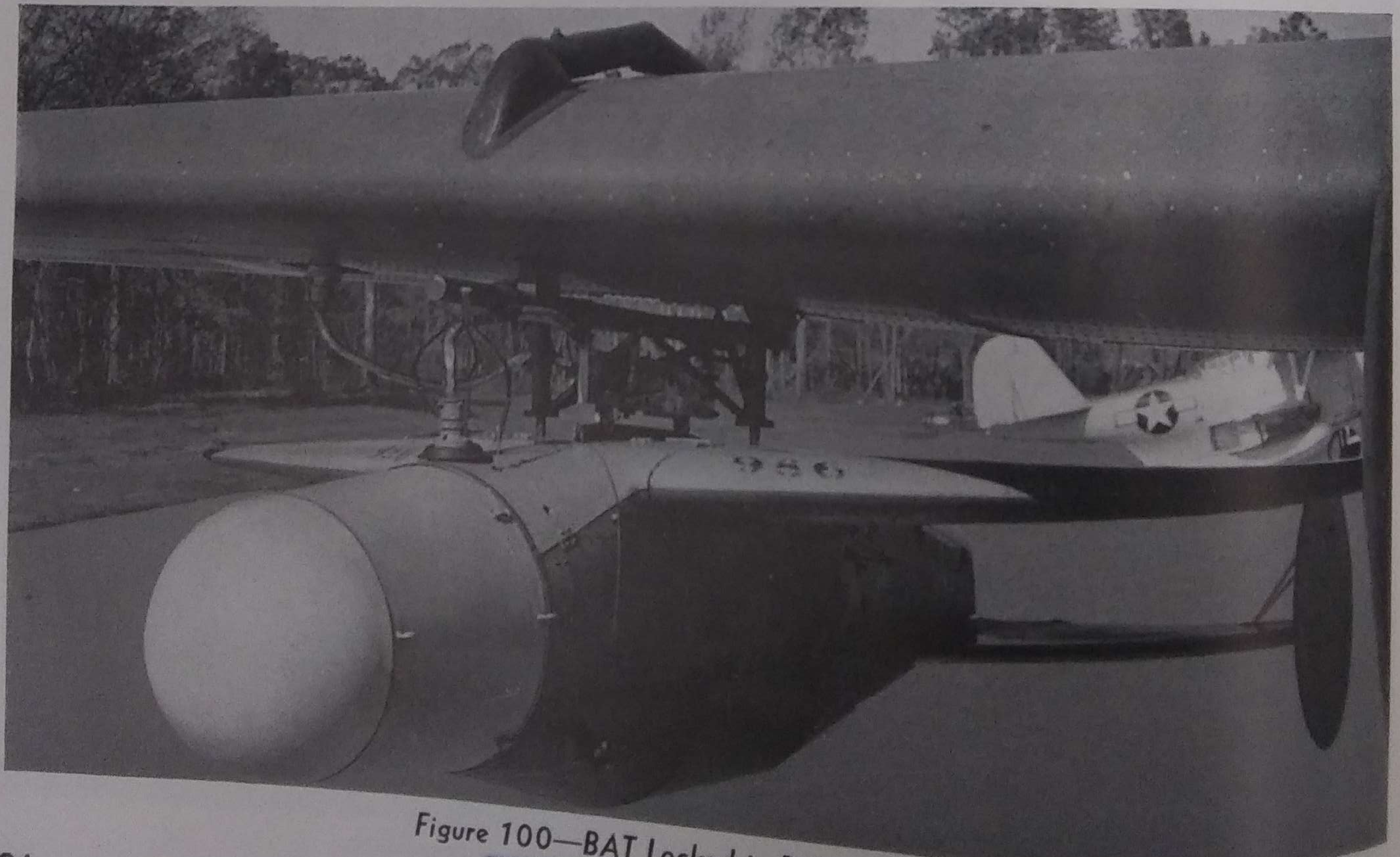

Figure 100—BAT Locked in Release Rack.

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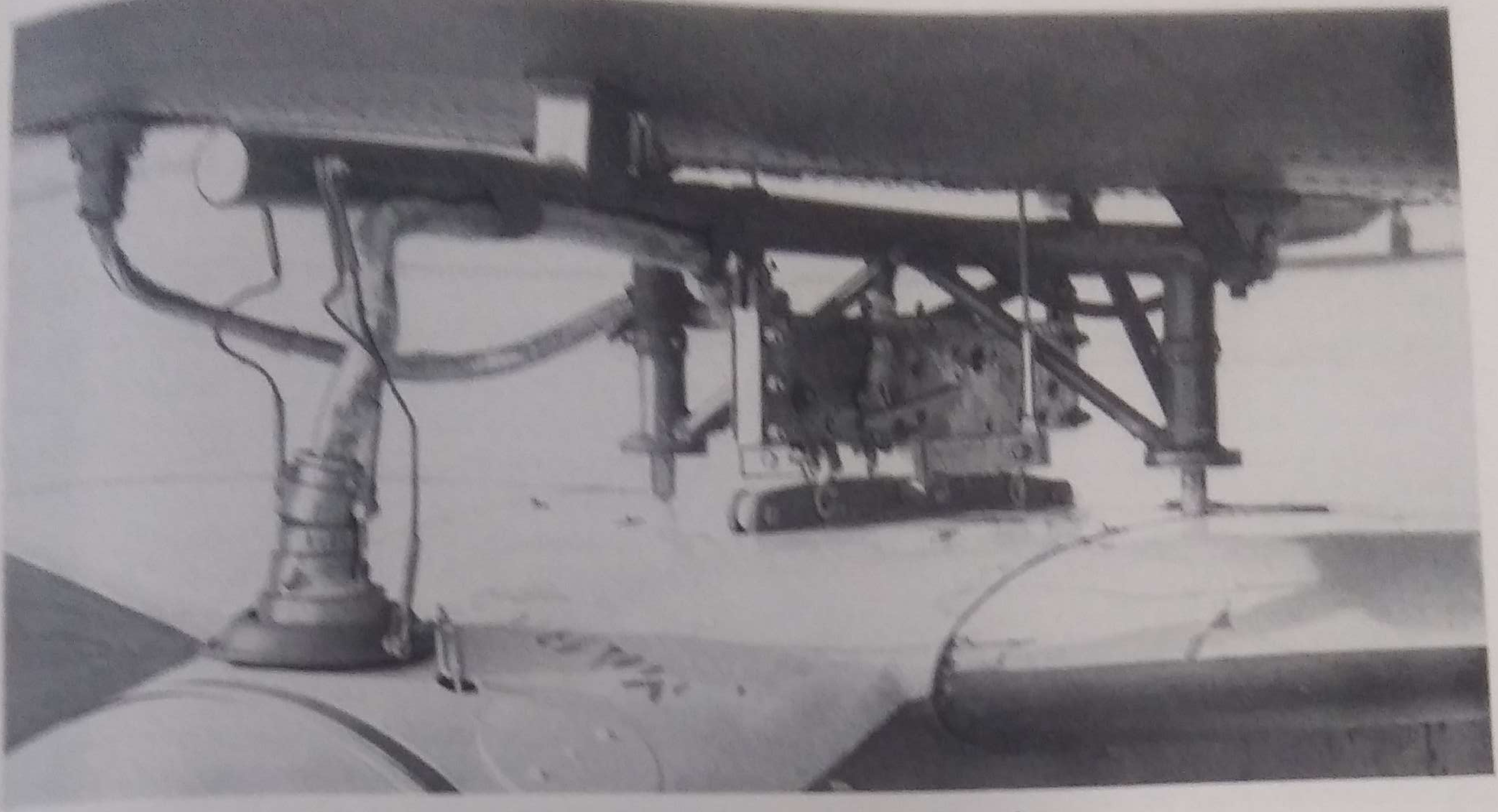

Figure 101—Completion of Hanging Procedure.

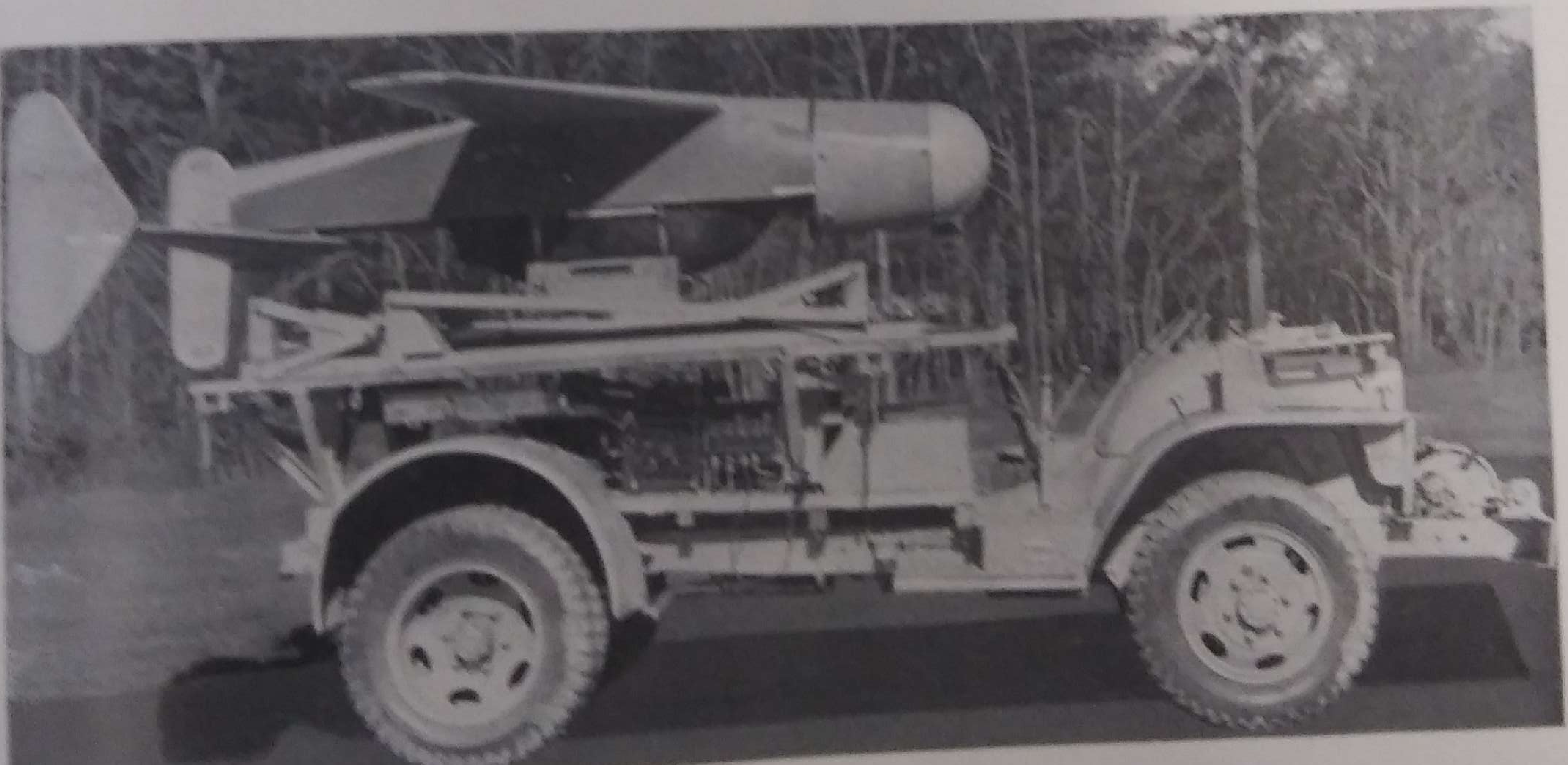

Figure 102—Modified Bomb Truck.

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loading procedure. A discussion of this bomb truck and modifications necessary is given in **e** below.

In using this modified truck for loading, the same procedure for checking the release rack is followed as in (1) and (2) of **c,** p. 92. After the release rack has been checked the following procedure is suggested:

(1) Mount SWOD Mk 9 on modified bomb truck with power hoist.

(2) Drive truck under wing and line the suspension bar of the SWOD Mk 9 as closely as possible with the release rack.

(3) By hydraulic pressure lift the missile to the wing.

(4) Align the bomb suspension rack and lugs with the release rack.

(5) Lift bomb into place.

(6) Lock the rack. (Figure 103). **Note:** After locking in rack, the conventional loading procedure is followed as given in the preceding standard loading procedure, **c,** beginning with step number (8), page 94.

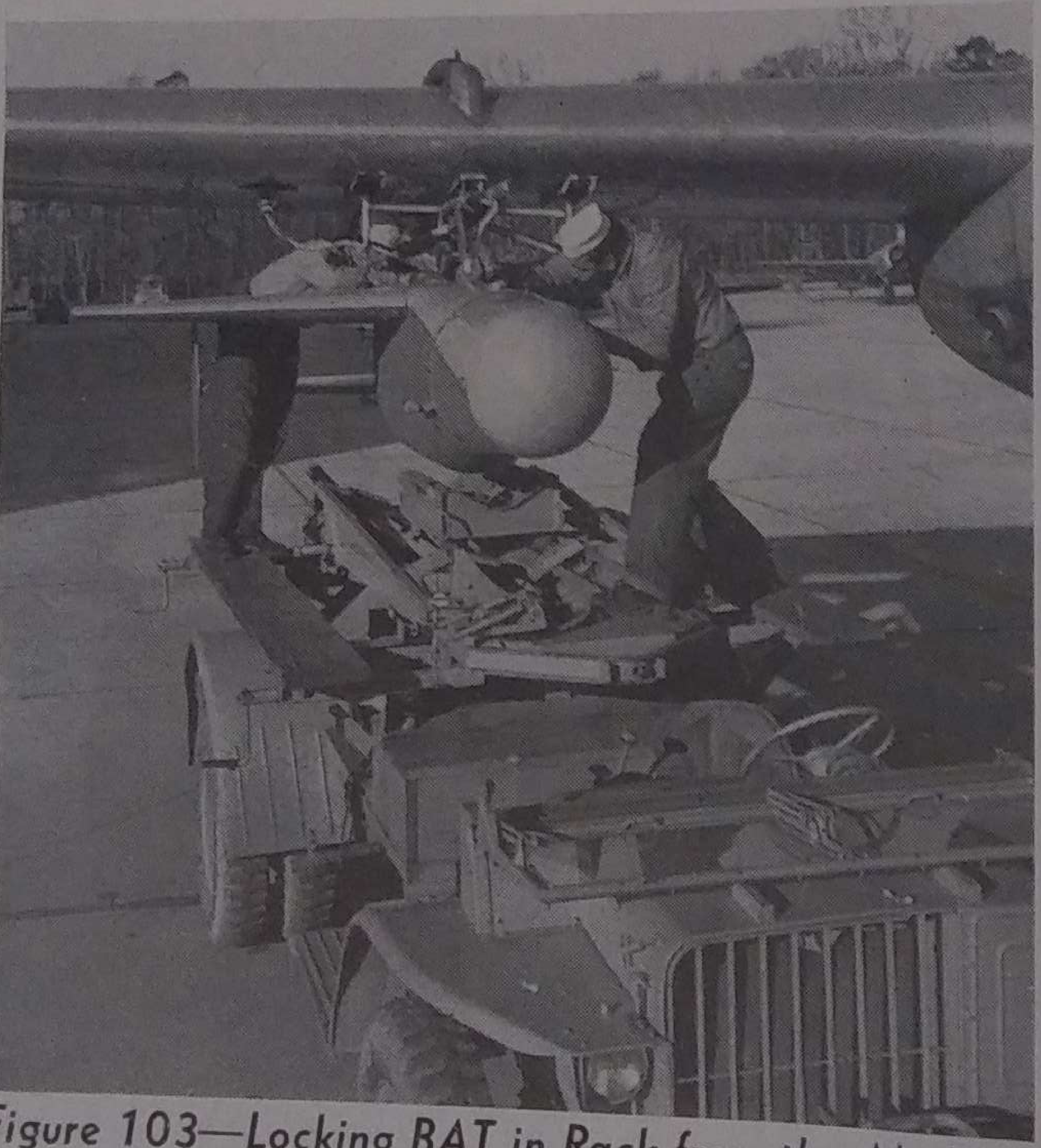

Figure 103—Locking BAT in Rack from the Modified Bomb Truck.

e. The Modified Bomb Truck

Purpose: To speed up loading, minimize danger in handling, and provide a device suited to loading various guided missiles as [illegible]l as being adapted for moving more than one specific Ordnance item.

Ordnance Material Used:

1—Bomb Truck Mk 2 Mod 2.
1—Torpedo Hoist Mk 22.
1—Bomb Skid Mk 1 (minus handles).
2—Jacking screws.

Stock Materials Used:

13 feet of 6-inch **I**-beams.
20 feet of 2½-inch angle iron, cut to fit.
12 feet of ¼-inch chain.
2 pieces of 2 inches x 12 inches x 10 feet standard ½-inch bolts and washers.
2 ¾-inch bolts.

Defined Construction:

(a) Cut away the bomb truck boom legs, leaving three stubs standing 4 feet 7½ inches above the ground.

(b) The forward **I**-beam and its legs are set on the stub of the original forward leg.

(c) The original forward leg, a 6-inch **I**-beam, was cut off 17½ inches above the channel iron, and left so as to be one of three legs supporting the forward **I**-beam. Such construction puts the upper surface of the **I**-beam 19½ inches above the bed of the truck or 4 feet 7½ inches above the ground.

(d) The after **I**-beam was cut to fit between two of the original stubs. The original stubs (4-inch **I**-beams) were cut off 17½ inches above the bed of the truck. This puts, likewise, the upper surface of the after **I**-beam 4 feet 7½ inches above the ground. **Note:** The framework is designed to be level with the ground rather than with the bed of the truck, so as to give lift forward and aft.

(e) The wheels of a Torpedo Hoist Mk 22 were removed and such hoist set on top of the **I**-beam framework.

(f) The outboard end of the jacking screws were secured under the catwalk, both on the right side, by using the fittings which were on those jacking screws and bolting such fittings with ½-inch bolts through the 2-inch planking. The jacking screw was set in the midout position before securing to the torpedo hoist. The inboard end of the jacking screws were cut off, hammered flat and drilled to receive a ¾-inch bolt to connect them with the torpedo hoist.

(g) Six positive stops were installed, four to

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control the lateral; the other two controlling the fore-and-aft movement of the torpedo hoist. The lateral stops are made up of 2-inch angle iron, 6 inches long, welded outboard of the torpedo hoist on the upper surface of the I-beams in such a position as to give the torpedo hoist 4 inches of lateral movement each side of the center line. The fore-and-aft movement is controlled by a 6-inch piece of channel iron installed to straddle the 6-inch I-beam surface on which the torpedo hoist rides.

(h) To enable fore-and-aft movement to some degree of accuracy when moving the truck under the shackle, a small window 9 inches by 4 inches was cut in the left front fender. With a piece of plexiglas covering the window and scribed line on the glass, the tread of the tire is sighted to move a given distance.

(i) A sight was installed on the center line of the windshield to enable the driver to come up under the shackle.

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Chapter 5

AIRCRAFT MODIFICATION AND CONTROL EQUIPMENT

1. TYPES OF AIRCRAFT SUITABLE

The SWOD (Special Weapon) Mk 9 may be used in conjunction with either land or carrier based operations. The aircraft which has been designated as the type of parent plane to carry the equipment in the fleet is the PB4Y-2. In no way does the carrying of this weapon interfere with flight operations or the armament devices normally carried by this aircraft.

Other types of aircraft which are suitable, with field modifications, and which were actually used as parent aircraft during development and testing are the PBY5-A, PBM-3, PBJ, PV-1, F4U, SB2C, and TBF. The PBN, F7F, and TBM are suitable but have not been used for this purpose.

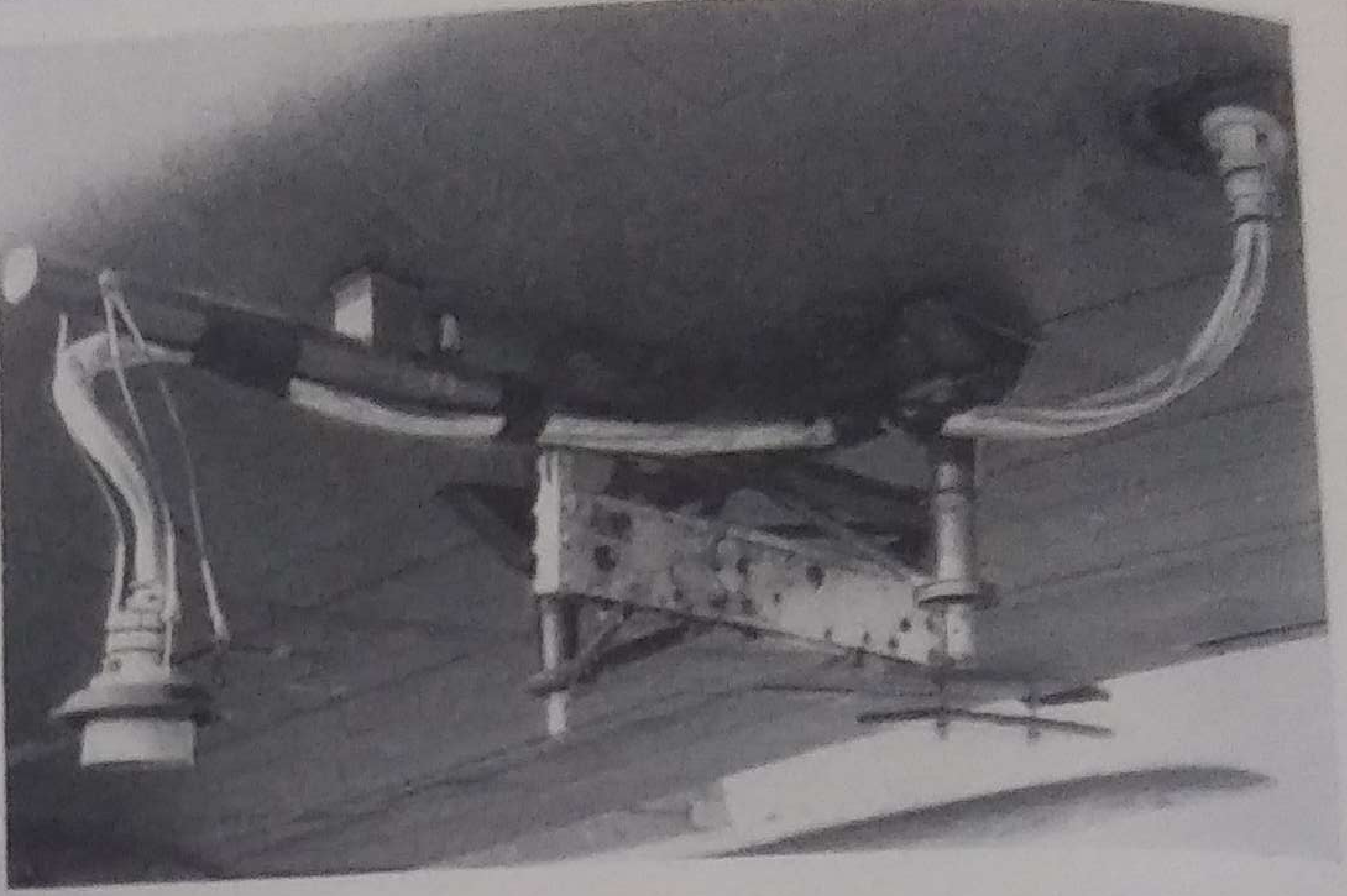

Figure 105—Bomb Rack Mk 51 Mod 7 for BAT.

2. MODIFICATION OF PB4Y-2 AIRCRAFT FOR SWOD MK 9 (BAT)

The PB4Y-2 installation provides for carrying two BATS, one under each wing outboard of the engines as shown in Figure 104. The complete modification is designed so that it may be made at an advanced base. This modification is covered by NAMU Report No. NO-R-0029.

A special bomb support rack is installed on each wing and consists of a strong-back member for the main support, placed on the top side of the wing with its front and rear shoes resting on the front and rear main wing spars, respectively. Figure 105 shows the framework on the under side of the wing which provides a mount for the standard Bomb Rack Mk 51 Mod 7 from which the BAT is suspended. This framework also provides sway bracing with adjustable pins that extend to seats provided on the top side of the steel center section of the air stabilizer fuselage. Two chutes with rollers are placed in each wing of PB4Y-2 through which cables are passed for hoisting the BAT up to the bomb rack.

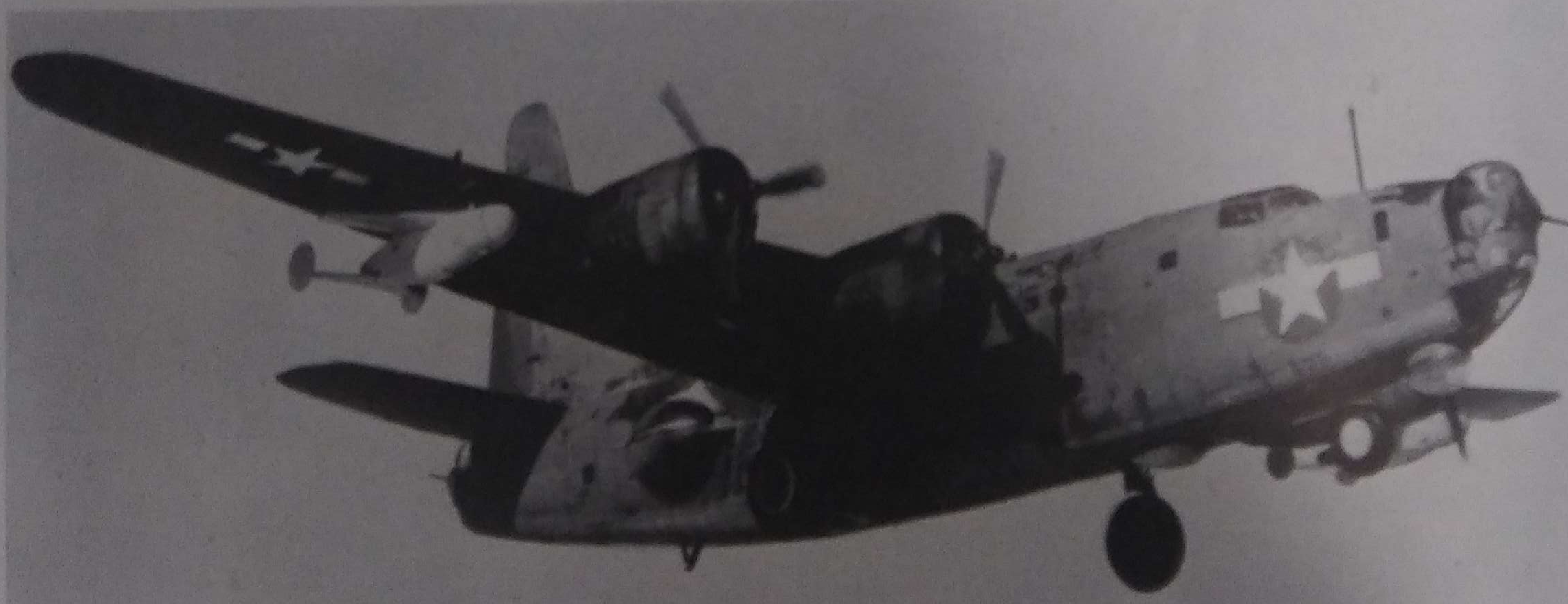

Figure 104—PB4Y-2 With BAT On Each Wing.

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The cables required to connect the radar of the SWOD Mk 9 with the aircraft control equipment, and the bomb rack with the armament switch box and bomb release switch, are run in through the wings. These cables in the aircraft run out from the fuselage in each wing behind the main wing spar to the inboard end of the aileron where they go forward through the main wing spar. The bomb release control cable terminates at the bomb rack. The control cable of the BAT terminates at an umbilical wing receptacle which is recessed into the wing. When the BAT is mounted, a short removable cable is used to connect the wing receptacle and the umbilical connector on the junction box of the radar equipment located in the SWOD Mk 9.

The armament switch box, firing key, and the additional interphone station box are located near the monitoring equipment.

The weight increment of the special equipment installed on the PB4Y-2 for BAT is approximately 352 pounds.

3. AIRCRAFT CONTROL EQUIPMENT

a. General

Either of three types of monitoring equipment may be used for remotely controlling the BAT from the aircraft before it is launched toward the target. These equipments are essentially the same but differ in the number of missiles which can be controlled from each. They are designed so that either one, two, or three BATS may be carried, depending on which monitoring equipment is used. These are:

Monitor Mk 3 Mod 0 (Control Group AN/-APA-67) Single Channel Unit.
Detailed description in OP 687 (CO-NAVAER 16-30 APA 67-500).
Monitor Mk 2 Mod 2 (Control Group AN/-APA-66) Dual Channel Unit.
Detailed description in OP 1648 (CO-NAVAER 16-30 APA66-500).
Monitor Mk 2 Mod 1 (Control Group AN/-APA-65) Triple Channel Unit.
Detailed description in OP 689 (CO-NAVAER 16-30 APA65-500).

In each Monitor the operator's controls are on the panels of two units, the indicator and the control unit. These two units are mounted in a rack for support which also acts as a junction box for various cables.

b. List of Equipment Used in the PB4Y-2 Aircraft

(1) Monitor Mk 2 Mod 2 (Control Group AN/APA-66) Dual Channel which consists of the following units: Control Unit (Control Monitor C-437/APA-66); Operator's Indicator, ID/Mk 2 and 3 (Indicator ID-229/APA-65); Rack, MT/-Mk 2 (Mounting Rack MT-565/APA-65). (See Figure 106.)

(2) Pilot's Indicator CAY 22446 (Figure 107).

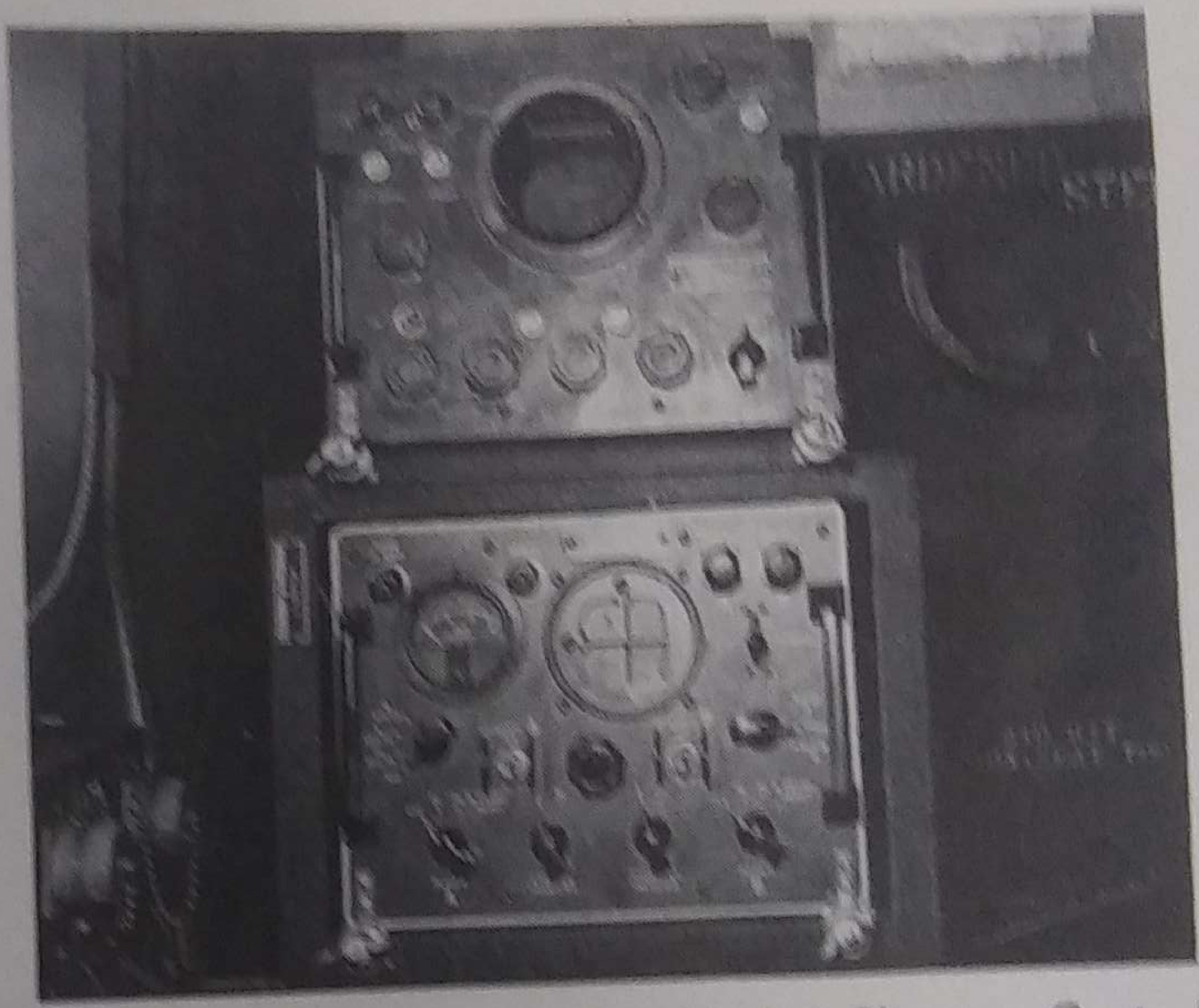


Figure 106—Monitor Mk 2 Mod 2 Showing Control Unit, Indicator, and Rack.

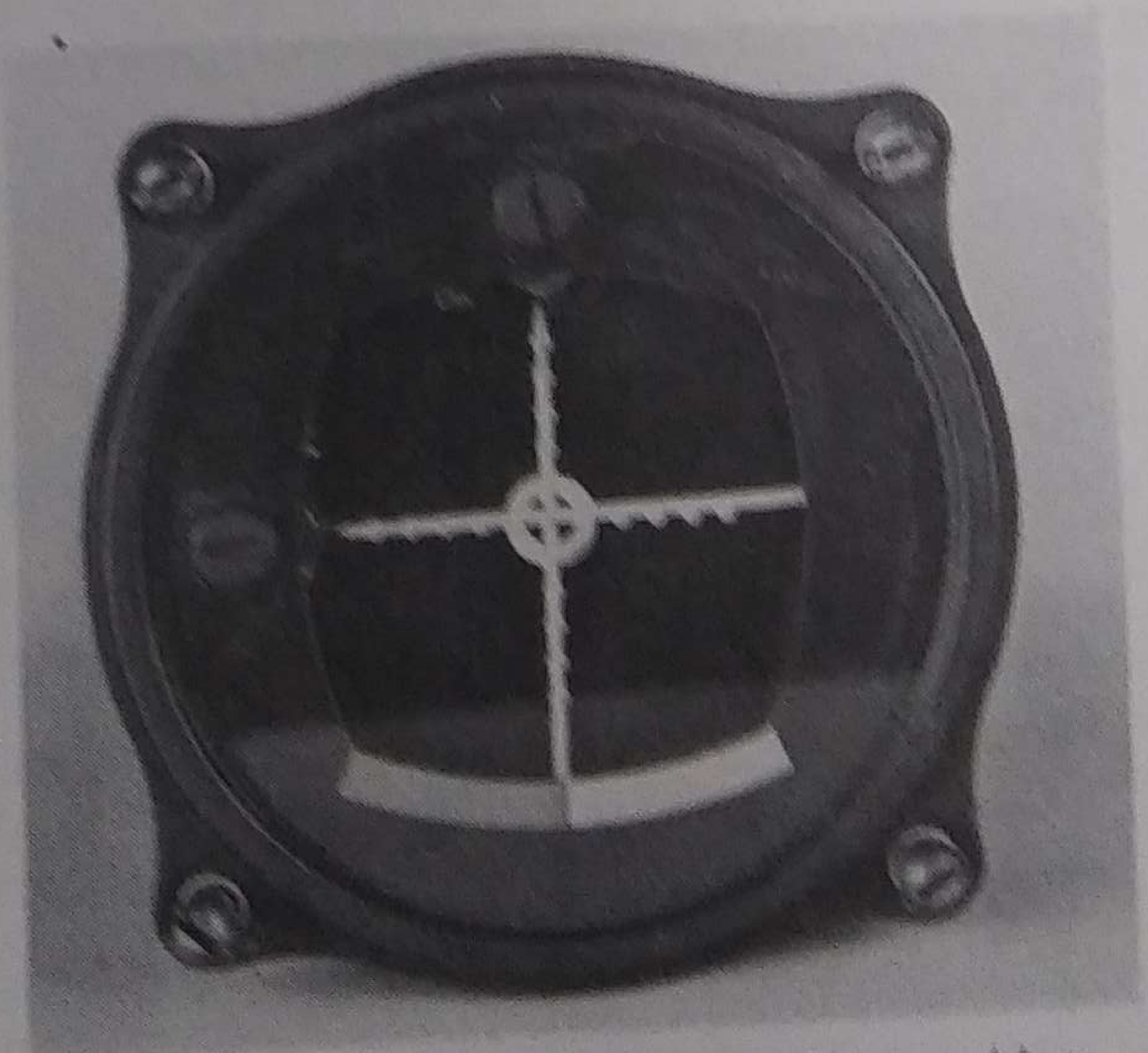


Figure 107—Pilot's Indicator Meter.

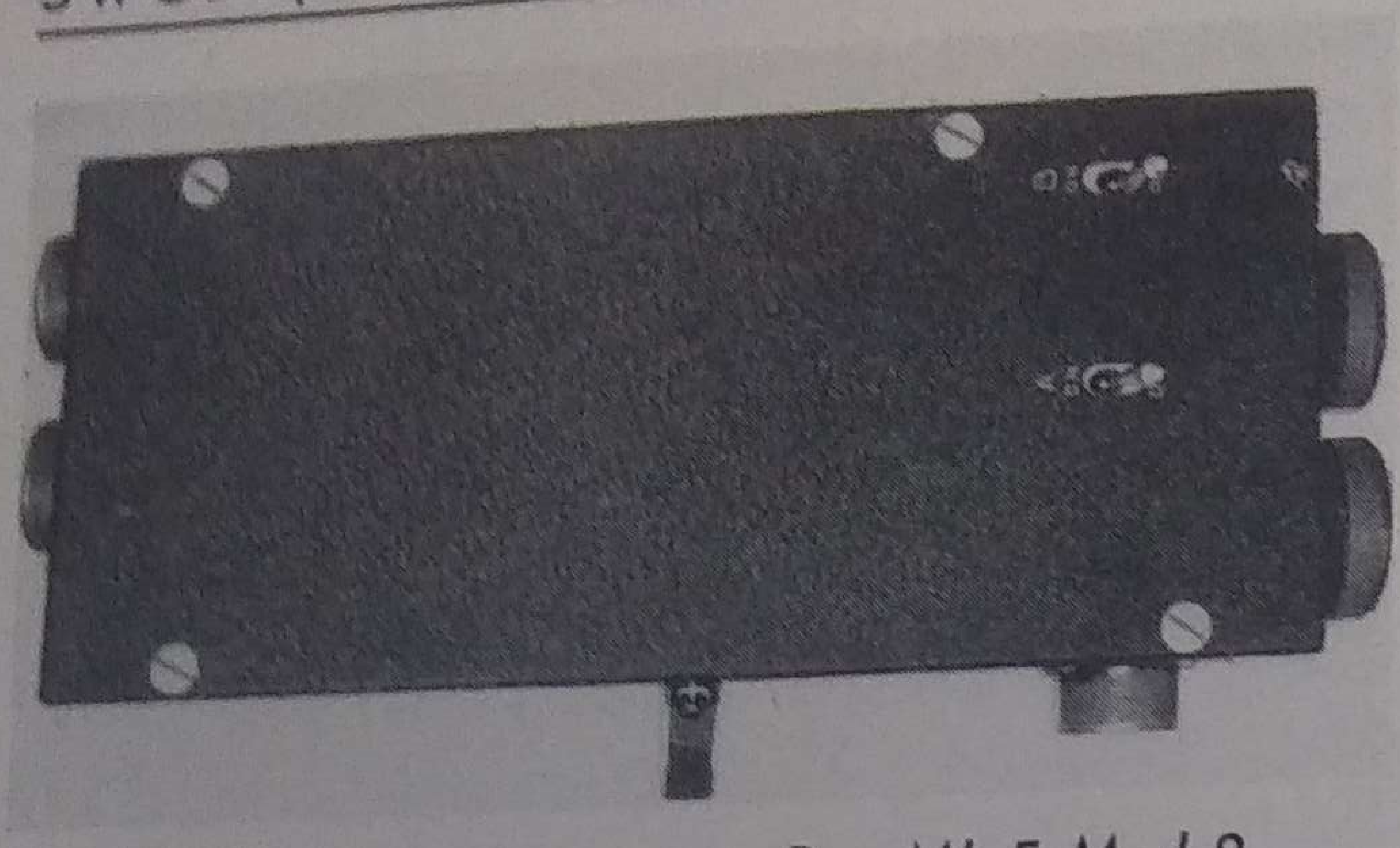


Figure 108—Connection Box Mk 5 Mod 2.

(3) Connection Box Mk 5 Mod 2 (Junction Box J–234/APA–66) (Figure 108).

(4) Wing Junction Box.

(5) Armament Switch Box (Figure 113).

(6) Range Unit (Coordinator) Mk 9 Mod 0 (SN–48/AP).

(7) AN/APS–15 Search Radar.

c. Description of Control Equipment Used in the PB4Y–2

LOCATION OF EQUIPMENT IN AIRCRAFT: The aircraft control equipment installed in the PB4Y–2 for BAT operation is the Monitor Mk 2 Mod 2 (Control Group AN/APA–66) and associated equipment listed above. The location of this equipment in the PB4Y–2 is as follows: (See Figure 109.)

EQUIPMENT	LOCATION
Monitor Mk 2 Mod 2 (Control Group AN/APA–66)	On the port side of the main flight deck across from the radar operator (Figure 109).
Connection Box Mk 5 Mod 2 (Junction Box J–234/APA–66).	On the port side slightly abaft the BAT operator (Figure 110).
Pilot's Indicator-----	In front of the pilot on the meter panel (Figure 111).
Armament Switch Box.	On the port side of the BAT operator.
APS–15 Radar------	In its normal location on the starboard side of the main flight deck (Figure 112).
Range Unit (Coordinator) Mk 9 Mod 0.	The control box of the coordinator is located on top of the APS–15 receiver indicator and the range unit sets beneath the APS–15 equipment (Figure 112).

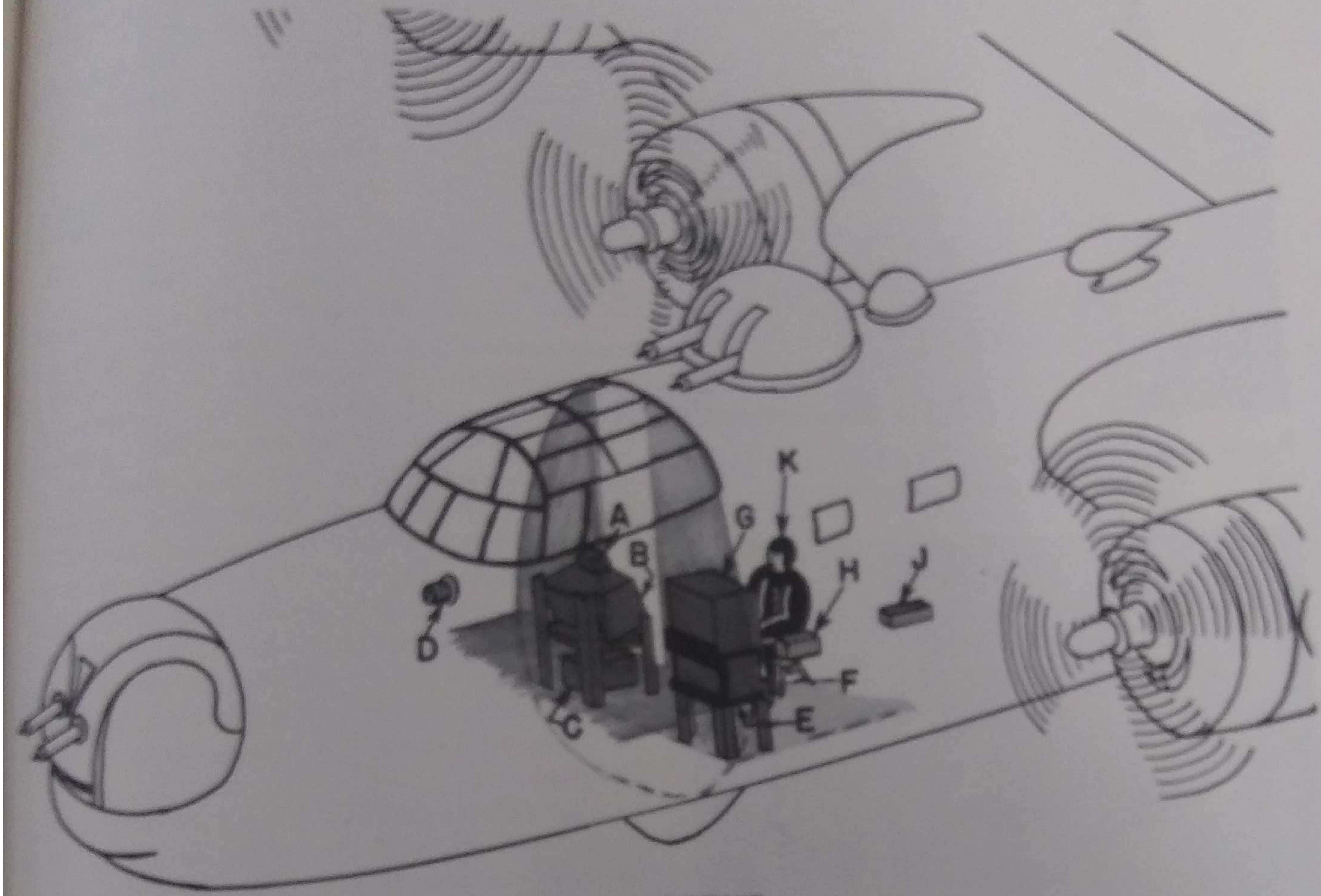
MONITOR MK 2 MOD 2 (CONTROL GROUP AN/APA–66). The Control Unit (C–437/APA–66) of Monitor Mk 2 Mod 2 (Control Group AN/APA–66) is designed to operate either one or two BAT equipments. It contains power switches for turning the BAT on and off and for transferring it from the plane power supply to the missile's own internal battery power. Separate switches are also supplied for the spinner and for switching the operator's indicator and pilot's indicator meter to either of two channels. Tuning of the BAT's radar receiver, slewing of the range gate and switch-over to automatic tracking are accomplished from this unit. The operator's indicator meter shows the direction of the target from the parent plane. The meter in the upper port corner of the panel of the Control Unit (C–437/APA–66) may be switched to read the battery voltage of either BAT or the plane voltage. If switched to its lower position it is connected into the automatic gain circuit of the BAT and shows the intensity of the target echo which is an indication of the size and character of the target.

The Indicator Unit (ID–229/APA–65) of the monitor contains an oscilloscope with Class "A" target presentation. Three range scales are provided: 25 nautical miles, 10 nautical miles, and a test scale of approximately 2.5 nautical miles. This unit is conventional in use with the exception of the release-range feature which automatically indicates the limits between which the BAT should be released when the altitude is indicated on the scope or is known. The indicator unit requires 115 volt a-c power which is supplied from an inverter in the parent plane.

PILOT'S DIRECTIONAL METER. The pilot's directional meter is similar to the directional meter on the face of the control unit. The point at which the needles cross indicates the direction of the target with respect to the course of the parent plane (pitch indication depends upon several factors). See Figure 107.

CONNECTION BOX MK 5 MOD 2 (JUNCTION BOX J–234/APA–66). The connection box provides a junction point for the cables from the monitor and the BAT and for the input of the 26.5-volt d-c power from the plane generator (Figure 108).

WING JUNCTION BOX. The wing junction box is required to furnish a junction point from the missile to the connection box located on the main flight deck of the aircraft.



LEGEND

A. CONTROL BOX ⎤ RANGE COORDINATOR MK 9
C. RANGE UNIT ⎦
B. AN-APS 15 RECEIVER-INDICATOR
D. PILOT'S INDICATOR
E. RACK ⎤
F. CONTROL UNIT ⎥ MONITOR MK 2 MOD 2
G. INDICATOR ⎦
H. ARMAMENT SWITCH BOX
J. CONNECTION BOX MK 5 MOD 2
K. BAT OPERATOR

Figure 109—Location of Control Equipment in PB4Y-2.

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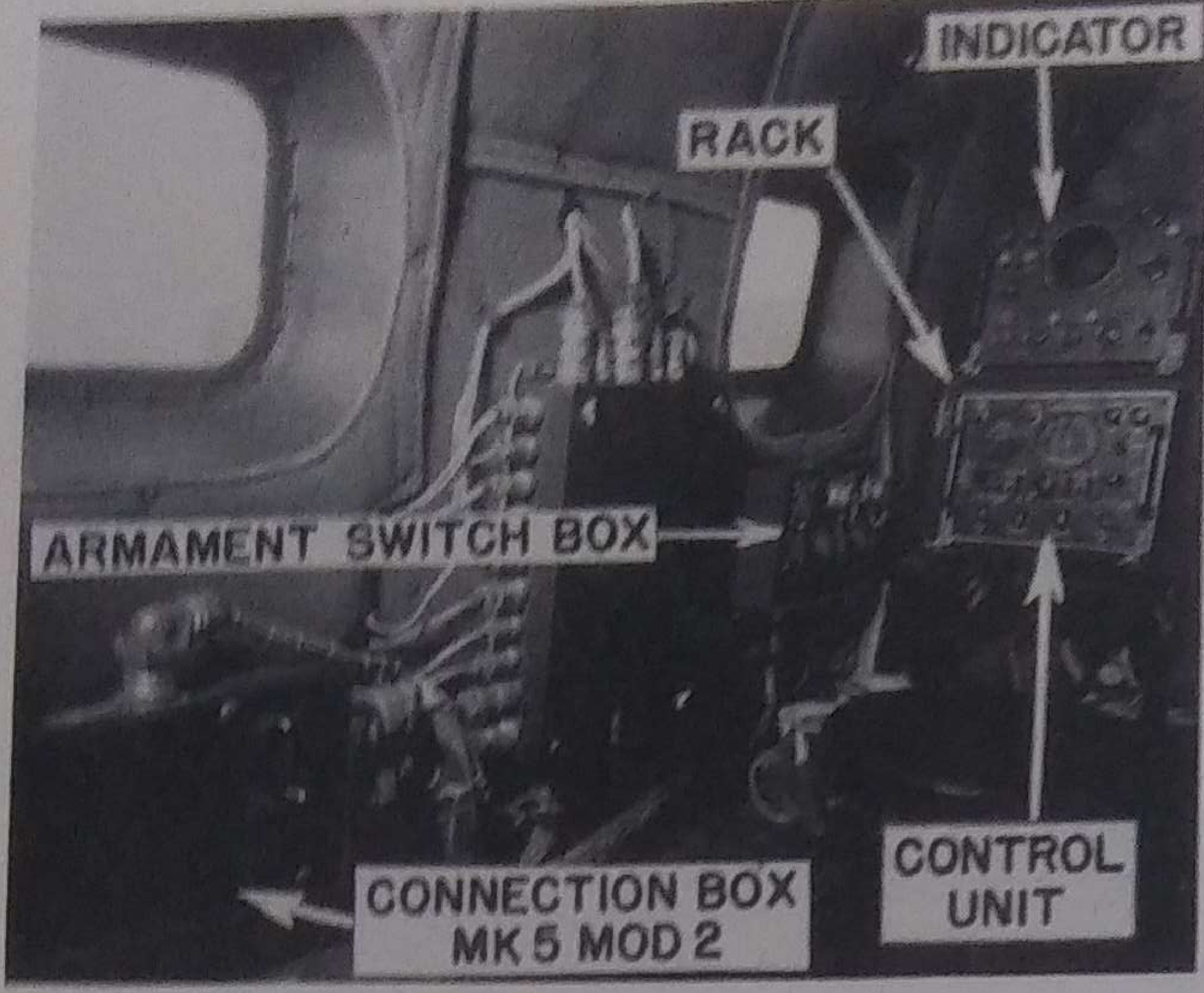

Figure 110—BAT Operator's Location in PB4Y-2 Showing Control Equipment.

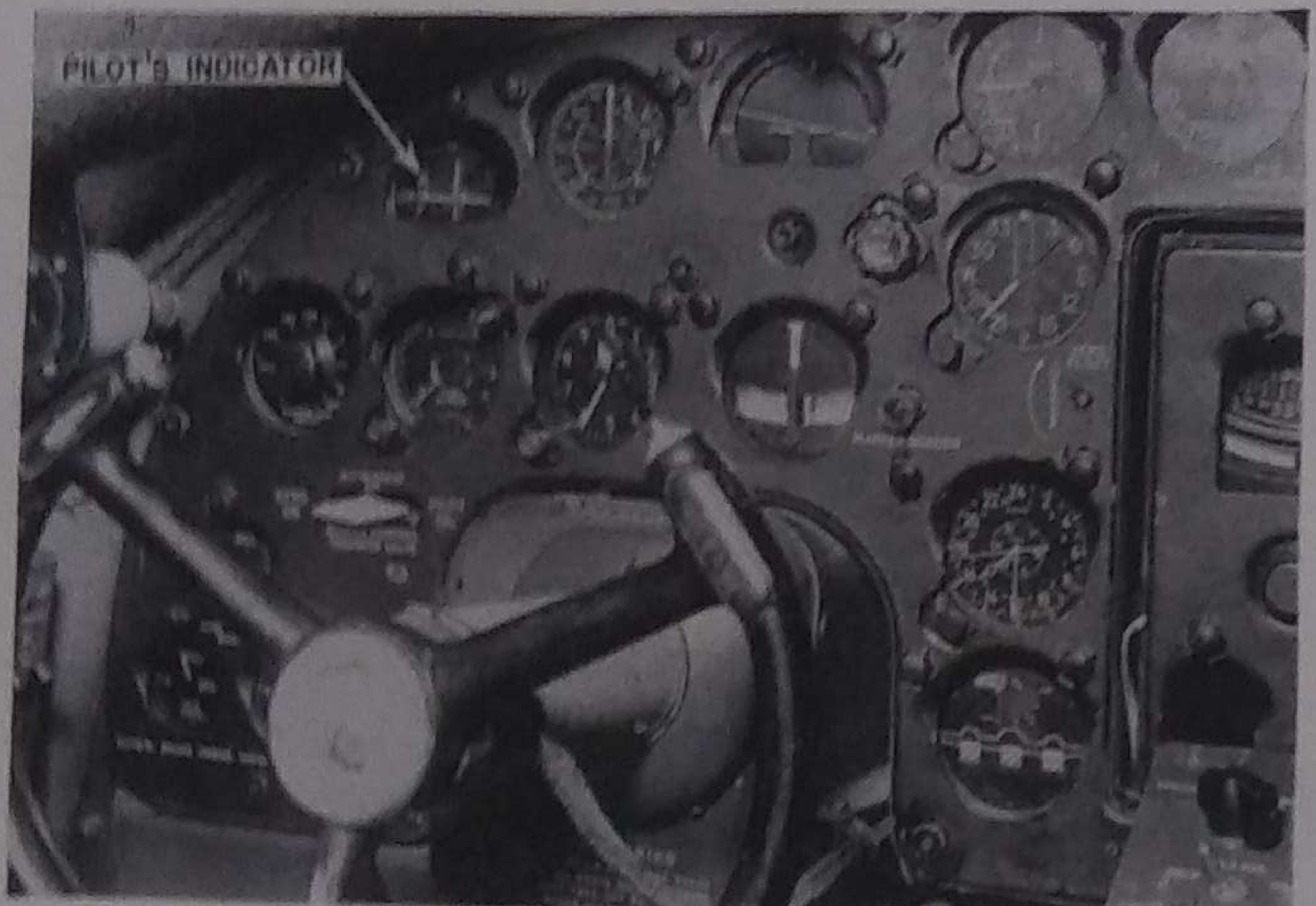

Figure 111—Pilot's Meter Panel.

Armament Switch Box. The armament switch box, shown in Figure 113, provides arming and launching circuits for both the Mod 0 and Mod 1 missiles. In neither case is the release circuit energized until the switches of the radar monitoring equipment have been properly set up. In the case of the Mod 1 unit, the release circuit is not energized until gyro uncaging is complete; i. e., closing the firing key uncages the gyro before releasing the missile. Jettison switches are provided for bypassing the normal interlocks in an emergency. Figure 114 is a schematic of the armament switch box circuits.

The armament switch box includes the control circuits required for uncaging the free gyro of the SWOD (Control System) Mk 18 Mod 1 (Flight Control Servo PU-146/DPN-2) which is used with the Mod 1 BAT.

Cables: Five cables are required to connect the armament switch box with other equipment. For functions of these cables emanating from the switch box refer to Figure 151.

Switches: Refer to Figure 115, a simplified schematic of the control circuit for the SWOD Mk 9 Mod 1, to visualize the purpose of the following controls:

(1) MASTER Switch. The Master switch supplies plane power for all indicating, arming, and release functions except the Caged light which is connected to the input side of the Master switch.

(2) JETTISON Switch. The Jettison switch is provided for the quick release of the BATS in an emergency. Normally, the release of a BAT is possible only if the firing relay "F" in the armament switch box is energized. Since this relay is energized by the glider battery only if all interlocks circuits of the monitor are properly set, a Jettison switch is provided to bypass this relay, and also the gyro circuits, so that the BATS may be dropped instantly if necessary for the safety of the plane.

To jettison the BATS, it is necessary that the Master switch and desired Select switch be in the ON position. The Jettison switch is safety-wired to prevent accidental tripping.

(3) REMOTE JETTISON Switch. The Remote Jettison switch located on the side of the switch box connects the wing racks to the normal bombing circuits of the aircraft to enable the pilot to jettison the equipment during an emergency. This switch is normally thrown ON during take-off. In arranging for the pilot to jettison the BATS, the BAT operator must throw the Remote Jettison switch and both Select switches. The Master switch need not be on for the pilot to remotely jettison the equipment. However, the Power and Manual switches of the bombardier's panel in the nose of the aircraft must be ON.

(4) SELECT Switch. There are two Select switches; one for the port channel and one for the starboard channel. By these switches the operator may select which of the BATS is to be dropped; port, starboard, or both in case of emergency.

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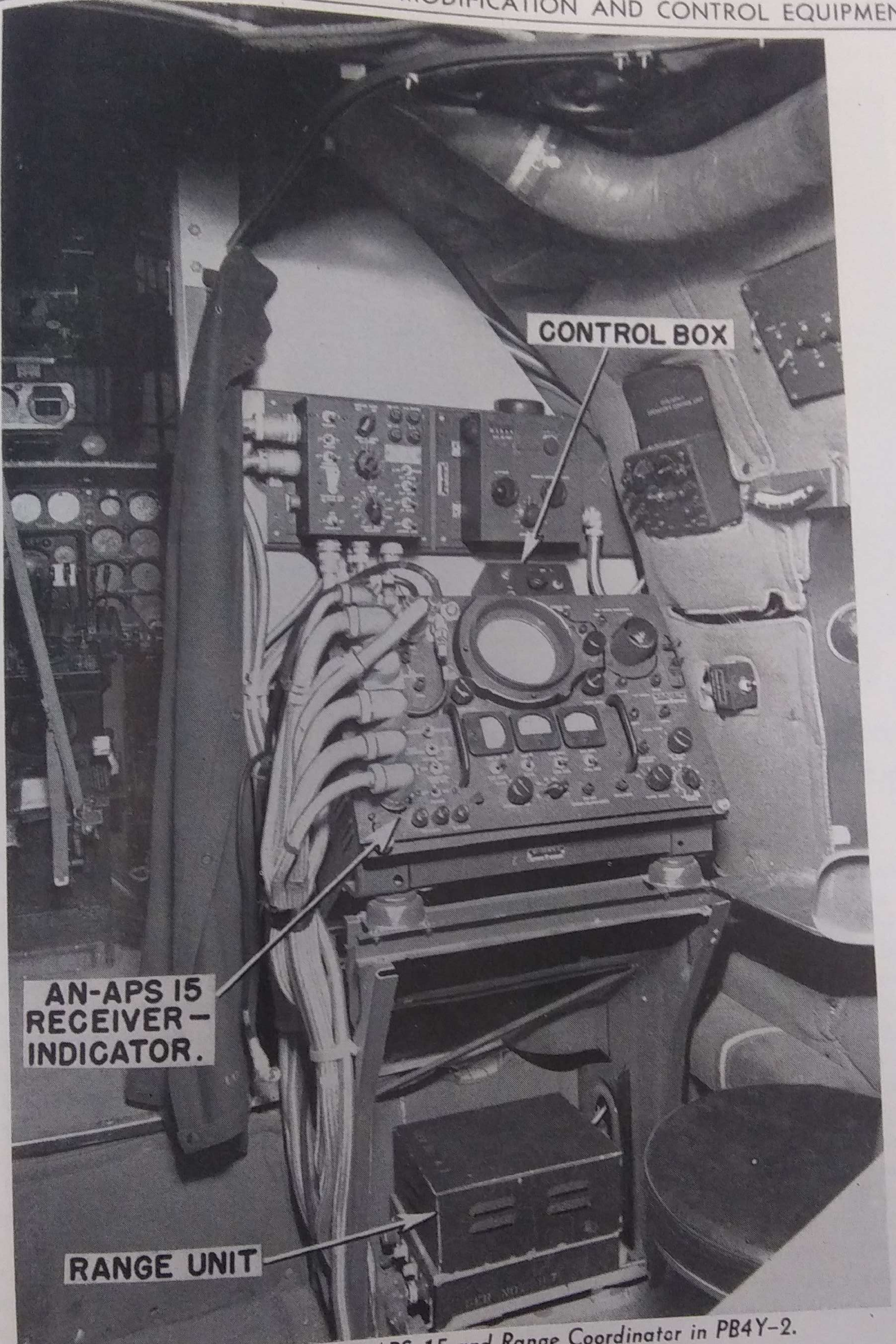

Figure 112.—Location of APS–15 and Range Coordinator in PB4Y–2.

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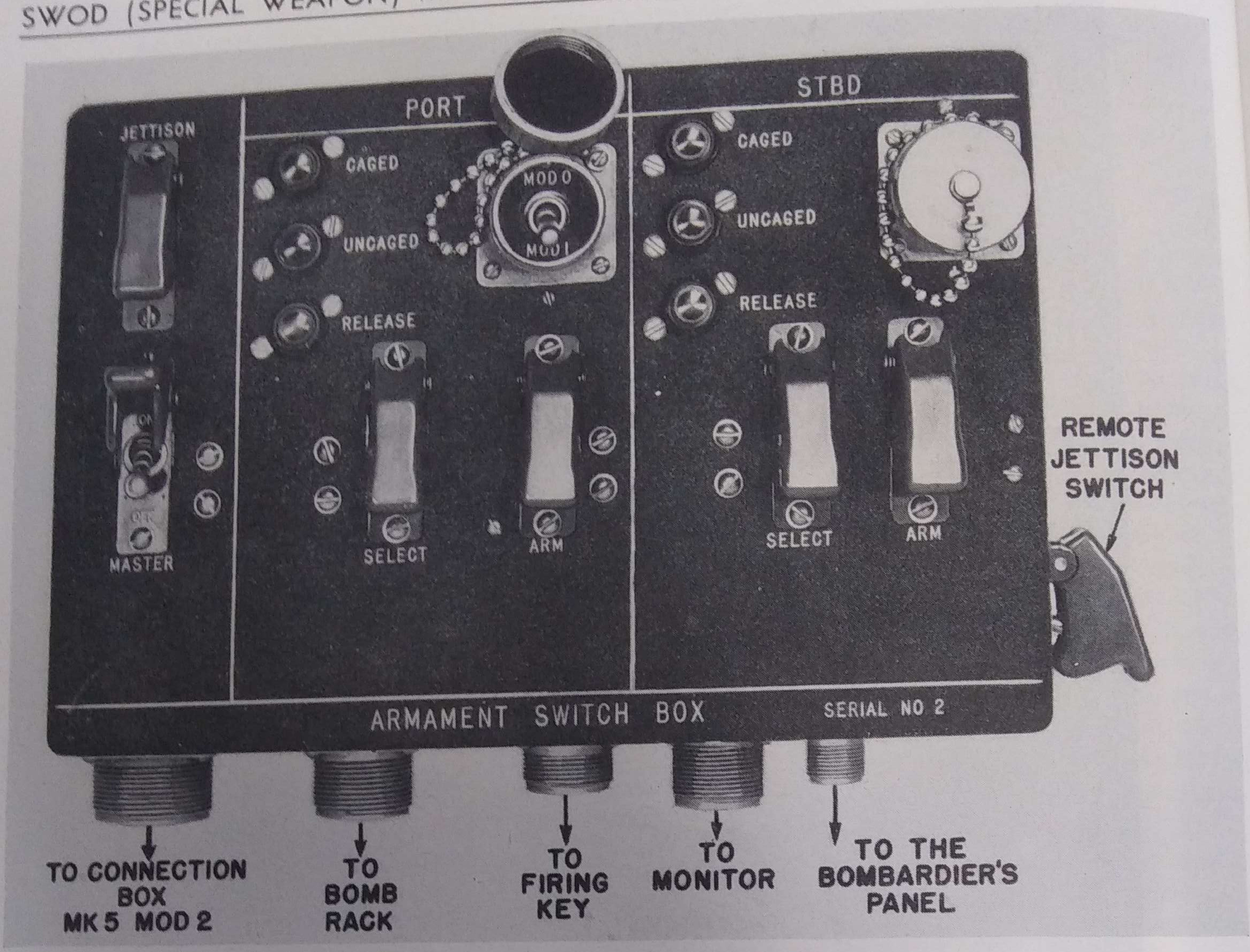

Figure 113—Armament Switch Box.

The release and uncaging functions may be checked without actuating the rack *if the select switch is unoperated.* A red lamp (marked UNCAGED) is connected to the plane side of each Select switch. If this lamp is lit, only the Select switch breaks the circuit to the rack.

(5) ARM Switch. There are also two Arm switches: one for the port channel and one for the starboard channel. By these switches, if the Master switch is ON, the operator may arm simultaneously the nose and tail fuze of either the port or starboard BAT or both.

(6) MOD 0—MOD 1 Switches. The covered Mod 0—Mod 1 switches must be in the proper position for the type of unit being carried. If the Mod 0—Mod 1 is in the wrong position for Mod 1 operation, the unit will be released while the gyro is still caged. On the other hand, if the switch is incorrect for Mod 0 operation, slewing will be impossible when the power switch on the monitor is thrown to PLANE position. In the latter case the Caged light will either light or burn out if the SWOD Mk 9 Mod 0 source of 115 volts A.C. from inverter (pin "S" or "Y" of breakaway connector J1604) is grounded. All Mod 0 systems must be checked to see that neither "S" nor "Y" is grounded.

Lights: The indicating lights are used to show visually certain conditions during switching. These are:

(1) RELEASE Lights. The Release light shows when the associated rack is cocked. This light is powered only when the Master switch is ON. The Release lights will light as soon as the

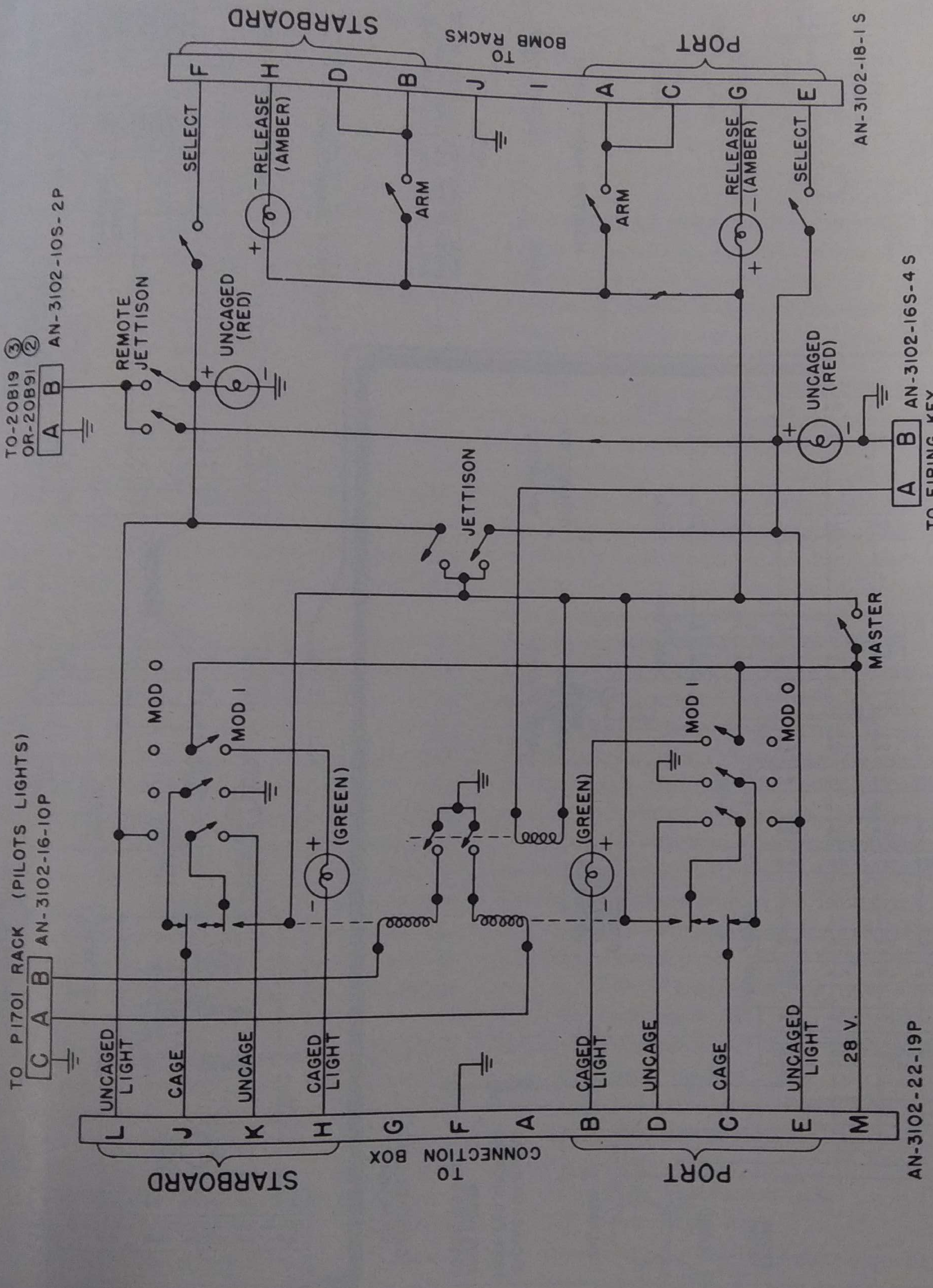

Figure 114—Armament Switch Box Schematic.

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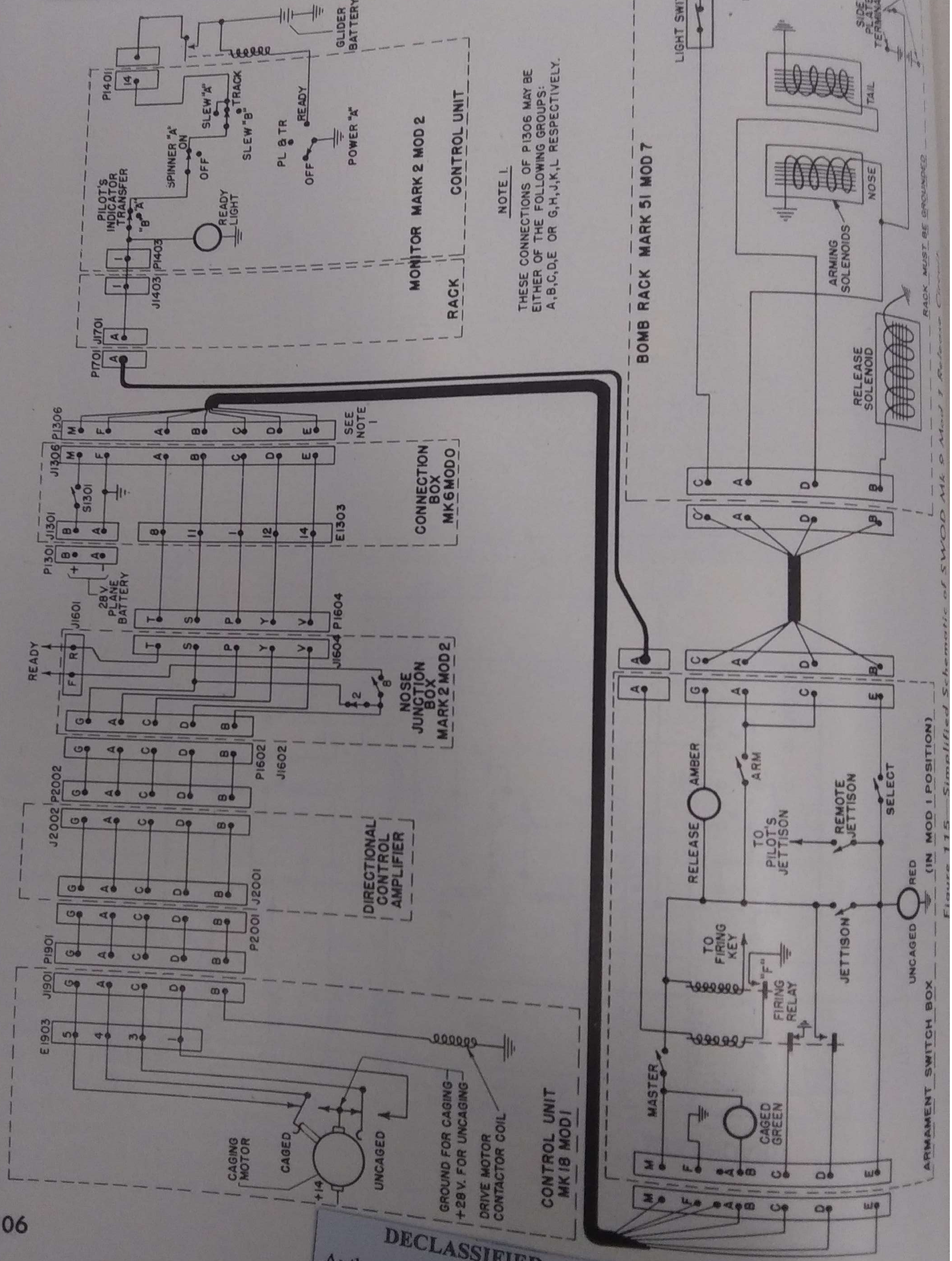

NOTE 1

THESE CONNECTIONS OF P1306 MAY BE EITHER OF THE FOLLOWING GROUPS: A,B,C,D,E OR G,H,J,K,L RESPECTIVELY.

Figure 115—Simplified Schematic of SWOD Mk 9 Mod 1 Release Circ

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Figure 115—Simplified Schematic of SWOD Mk 9 Mod 1 Release Circuit.

MASTER switch is thrown if there is a BAT in each rack. In case there is only one BAT hanging, then the RELEASE light corresponding to that channel will light. If there are no BATS the RELEASE lights will not light. After release of the bomb the respective RELEASE light goes out.

(2) CAGED Lights. The CAGED lights are never on when the SWOD Mk 9 Mod 0 are being used. Both CAGED lights will light if two Mod 1 BATS are being carried. In case both a Mod 0 and Mod 1 BAT are being carried only the CAGED light in the Mod 1 channel is lit. The CAGED light goes out when uncaging starts.

(3) UNCAGED Lights. There are two UNCAGED lights: one for each channel. These are the red lights mentioned under SELECT switches. When the firing key is pressed to release a BAT Mod 0 the UNCAGED light flashes on momentarily as the bomb is released. When the firing key is pressed to release a BAT Mod 1 the corresponding UNCAGED light will not light until the gyro in the BAT control system is uncaged. This takes three seconds, at which time the release circuit to the bomb release rack is completed and the bomb drops away. This is the light which may be used for testing *if the Select switch is Off*.

(4) Another light which is not located on the armament switch box but which should be mentioned at this time is the READY light located on the Control Unit (Control Monitor C-437/APA-66) of the monitor. The proper READY light will light only when all switches on the control unit of the monitor necessary for the release of a BAT are in the proper positions. These lights operate through an interlocking system of switches to prevent release of a missile until all necessary switching has been accomplished. The same appropriate interlocking circuit furnishes power to the release relay mentioned in the following paragraph.

Relay Circuits: If certain conditions have been met in the armament switch box, relay circuits operate to release the missile. For purpose of explanation, in figure 151 these relays have been labeled relay "F" (firing relay), relay "A" (release relay for the port BAT "A"), and relay "B" (release relay for starboard BAT "B"). Also refer to Figures 115 and 116 while reviewing the following description of the circuit.

When the firing key is pressed relay "F" will close immediately to activate relays "A" and "B" under certain conditions. Relay "A" or "B" will then release either the port or starboard BATS depending upon which one had been readied by the BAT operator. For example, let us assume that the port BAT "A" is a SWOD Mk 9 Mod 1 and has been readied for release. This means that the pilot's indicator transfer, spinner, slew-track, and ready switches on the monitor are in the ON position and the READY light is lit. With this condition existing 28 volts from the glider battery appears at one side of relay "A". When the firing key is pressed, relay "F" closes and immediately places a ground on the other side of relay "A" and also on one side of relay "B". Relay "B" will remain an open circuit since the starboard BAT had not been readied for the drop. However, the circuit of relay "A" will be completed through the Mod 1 position of the MOD 0—MOD 1 switch. One contact of relay "A" through a microswitch in the Mk 18 control system removes the ground from the CAGED light allowing it to go out immediately and at the same time, through timing switch No. 2 in the nose junction box, allows the drive motor to be energized and brought to speed during the three seconds for uncaging the gyro. Contact 12 of the same relays, places 28 volts on a second microswitch in the Mk 18 control system which after 3 seconds is closed by action of the caging motor, thus energizing the release circuit in the rack through the proper (port) SELECT switch and allowing the port BAT to drop away.

Operations: In the operation of the armament switch box with the SWOD Mk 9 Mod 0 the following procedure should be followed: Figure 116 is a simplified schematic of the SWOD Mk 9 Mod 0 release circuit.

(1) Throw corresponding power switch (port "A" or starboard "B") on Monitor Mk 2 to READY. Complete all system adjustments.

(2) Close desired port or starboard ARM switch on the armament switch box.

(3) Close corresponding (port or starboard) SELECT switch.

(4) Close MASTER switch.

(5) Close firing key.

NOTE: Using the foregoing sequence of switching the release will be instantaneous when the firing

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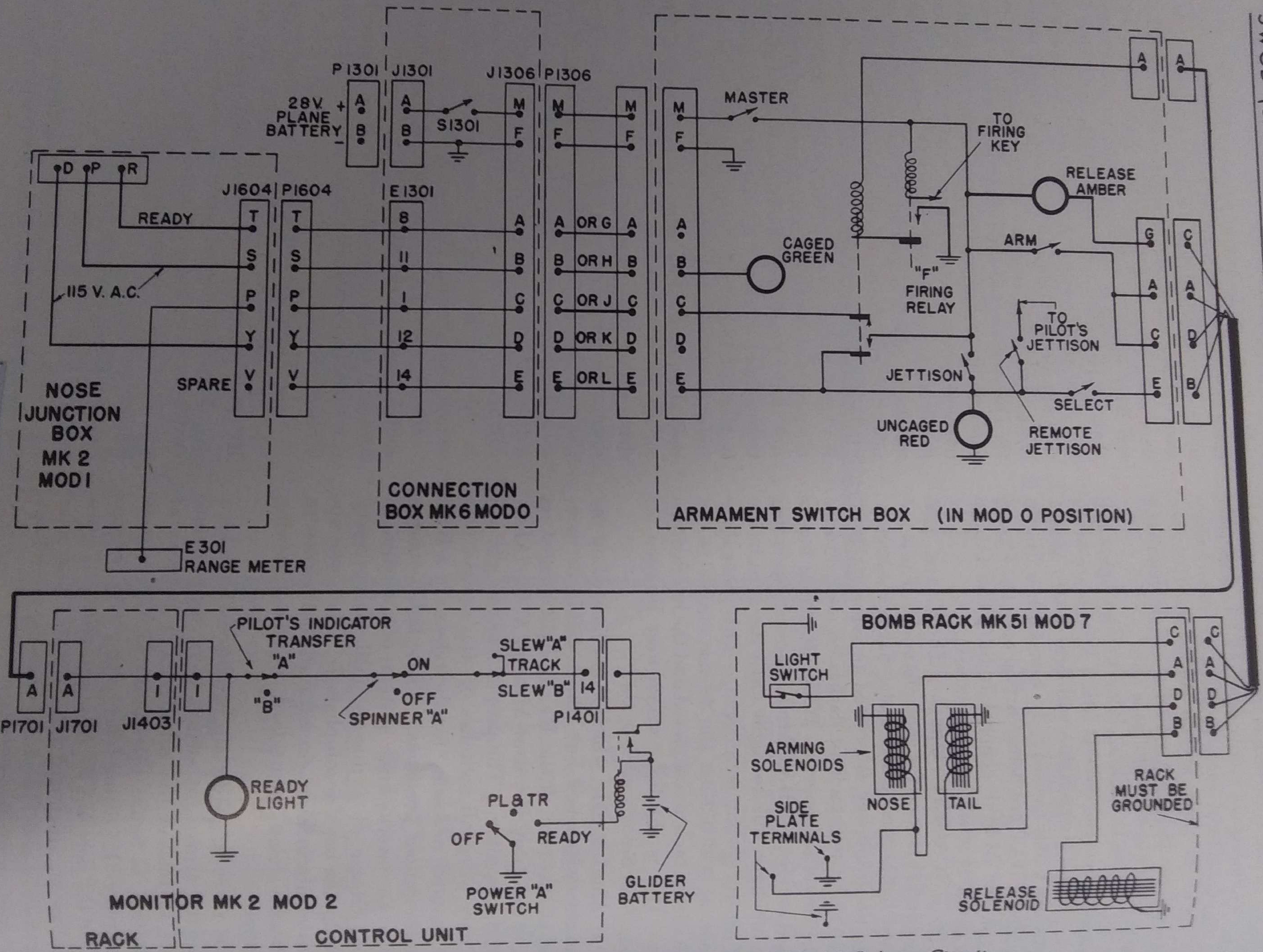

Figure 116—Simplified Schematic of SWOD Mk 9 Mod 0 Release Circuit.

key is closed. It should be noted that the CAGED light is never lit and that the READY light located on Monitor Mk 2 (Control Group AN/APA-66) is independent of the firing key and lights when the corresponding power switch of the monitor is thrown to READY.

In the operation with SWOD Mk 9 Mod 1 the following procedure should be followed. Figure 115 is a simplified schematic of the SWOD Mk 9 Mod 1 release circuit.

(1) Throw desired power switch (port "A" or starboard "B") on Monitor Mk 2 to READY. Complete all system adjustments.

(2) Close the corresponding (port or starboard) ARM switch on the armament switch box.

(3) Close corresponding (port or starboard) SELECT switch.

(4) Close MASTER switch.

(5) Close firing key and *hold closed.*

The unit will release when the uncaging of the gyro is completed, which is about three seconds after the firing key is closed. The SWOD Mk 9 Mod 1 cannot be released unless the READY light on the Monitor is lit, indicating that all necessary switches have been thrown, and unless the gyro uncaging is completed.

Testing the Gyro in SWOD Mk 9 Mod 1: Procedure for testing the gyro while in flight is accomplished by using the same switching procedure as above with the exception that the SELECT switch *must not be closed.* Otherwise the missile would drop away during test. In testing, the UNCAGED light will light when gyro uncaging is complete. Opening the firing key will return the gyro to a caged condition and the CAGED light will relight. **Note:** Plane must not be maneuvered while making this test.

RANGE UNIT (COORDINATOR) MK 9 MOD 0 (RANGE COORDINATOR SN-48/AP). Range unit (Coordinator) Mk 9 Mod 0 (Figure 117) is used by the AN/APS-15 search radar operator to designate to the BAT operator the target selected for attack. A detailed description of this equipment may be found in OP 1706, Range Unit (Coordinator) Mk 9 Mod 0 (Range Coordinator SN-48/AP).

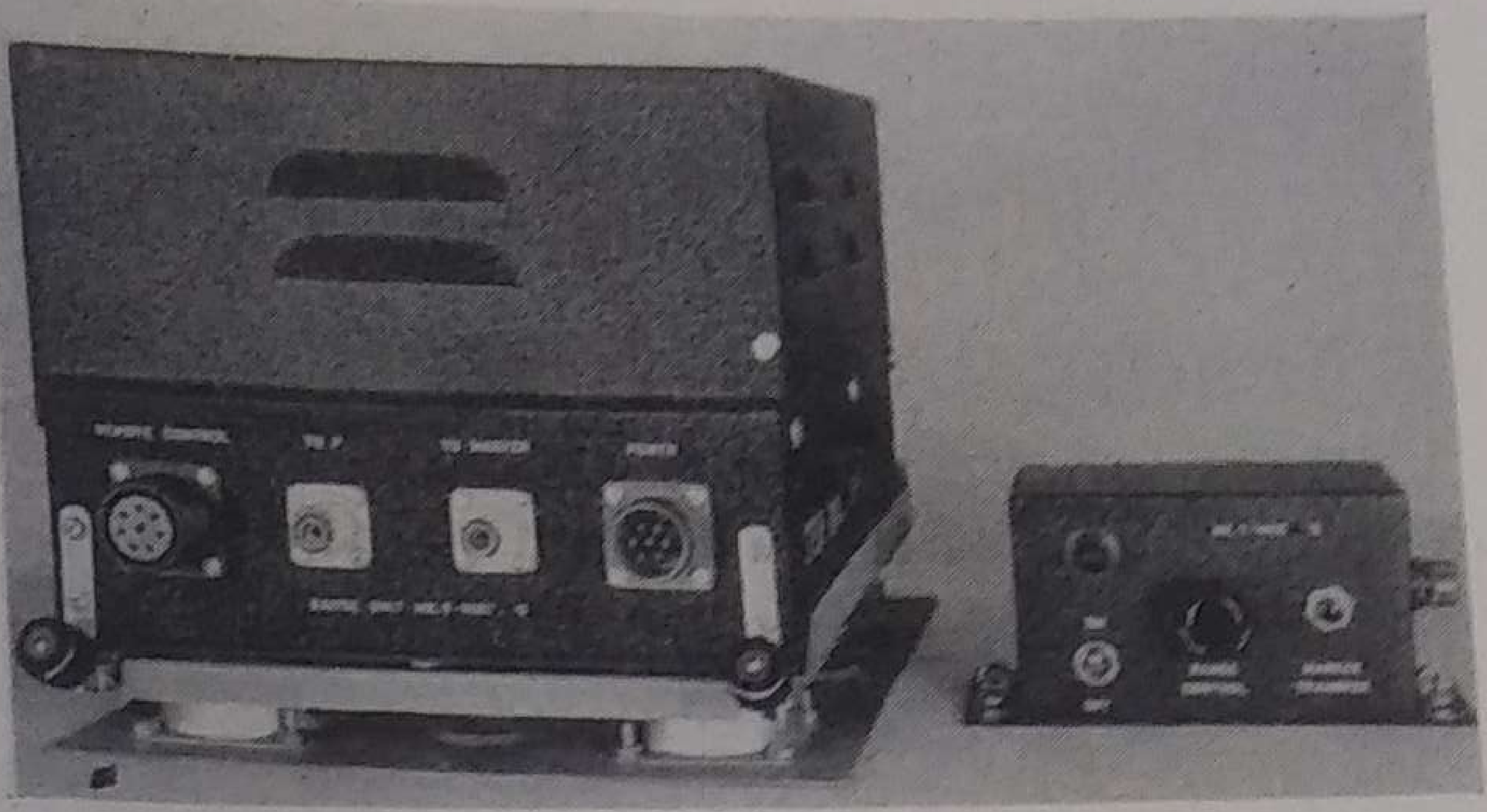

Figure 117—Range Unit (Coordinator) Mk 9.

AN/APS-15 SEARCH RADAR. The AN/APS-15 Search Radar is used by the radar operator to locate, identify, and select the target for attack. See Figure 112.

4. SWOD MK 9 (BAT) CONTROL EQUIPMENT PUBLICATIONS

For complete information concerning the aircraft equipment used with SWOD Mk 9 consult:

OP 687, CO-NAVAER 16-30APA67-500, Monitor Mk 3 Mod 0 (Control Group AN/APA-67).

OP 689, CO-NAVAER 16-30APA65-500, Monitor Mk 2 Mod 1 (Control Group AN/APA-65).

OP 1648, CO-NAVAER 16-30APA66-50, Monitor Mk 2 Mod 2 (Control Group AN/APA-66).

OP 1706, CO-NAVAER 16-353N48-500, Range Unit (Coordinator) Mk 9 Mod 0 (Range Coordinator SN-48/AP).

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OPERATION AND RELEASE DATA

1. TARGET DATA PRESENTATION FOR SWOD MK 9 (BAT) OPERATOR

In preparation for an attack, information concerning the target may be obtained by the BAT operator from the Monitor Mk 2 Mod 2 (Control Group AN/APA-66) Indicator Scope (ID-229/APA-65), the AVC meter, and the directional indicator meter. The latter two are mounted on the control unit (Control Monitor C-437/APA-66) of the monitor.

The Indicator (ID-229/APA-65) scope face markings are shown in Figure 118-A. The vertical lines indicate ranges out to 10 or 25 miles, depending upon the setting of the range switch. The two figures and the three markers at the bottom of the scope are indicators for the computing system which show maximum and minimum release ranges for various altitudes.

The appearance of the scope face under operating conditions is shown on Figures 118-B and 118-C. When no target echo is gated, the BAT receiver is at full sensitivity. This is shown in Figure 118-B. Figure 118-C represents the scope picture after an echo at approximately 6½ miles has been gated. In this instance, the AVC circuit has reduced the BAT receiver sensitivity and thus the echo and noise amplitudes. By aligning the altitude mark at the bottom of the scope with the leading edge of the altitude signal, "main bang" at zero, the remaining two marks define the maximum and minimum release range. Since the gated echo lies within this range, a drop may be made. The number "8" shown on the lower left hand corner of the scope picture indicates present altitude at 8,000 feet. Scope calibration can be checked by comparing this figure (obtained by aligning the altitude mark with the leading edge of the altitude signal) with the pilot's altimeter reading. The figure in the lower right hand corner of the scope shows altitude when operating on the 25-mile range scale.

The AVC meter on the Control Unit (Control Monitor C-437/APA-66) indicates approximately the amplitude of the gated echo. The larger the echo, the lower the reading on this meter. Since echo amplitude is determined by target characteristics and range and since range is shown on the face of the scope, target size may be approximated.

The directional meter is used for ascertaining the position of the gated target with respect to the heading of the plane.

Range and Altitude Relations

The effective glide ratios of the BAT are between 5½ to 1 and 3½ to 1 and the effective ranges are from 3 to 17 miles, depending on the altitude and the target size. Minimum launching altitude should be 4,000 feet. The average range at which a target can be locked on is approximately 12 to 15 miles.

These requirements give wide but well defined limits to the area from which release must be made for favorable homing conditions. Figure 119 illustrates the release area. It will be noted that at these glide ratios the glide angle is between 10° and 16° depending upon the altitude and range at the release point. These relatively low angles of glide permit operation outside the range of antiaircraft fire.

2. OPERATING TECHNIQUES

a. Team Work

To obtain the best results from the SWOD Mk 9 it is imperative that the pilot, BAT operator and search operator work as a team at all times. A discussion of the duties of each is given below.

SEARCH OPERATOR: Whether a mission is successful or not depends largely upon the skill and knowledge of the search operator. He is the only person in the aircraft who can observe the surrounding territory for ranges beyond that of normal vision. This he does by the use of the APS-15 PPI scope. A summary of his duties may be listed as follows:

(1) Recommend the target for attack.

(2) Identify it as far as size, direction of travel, etc. are concerned.

(3) Direct the pilot to the proper course.

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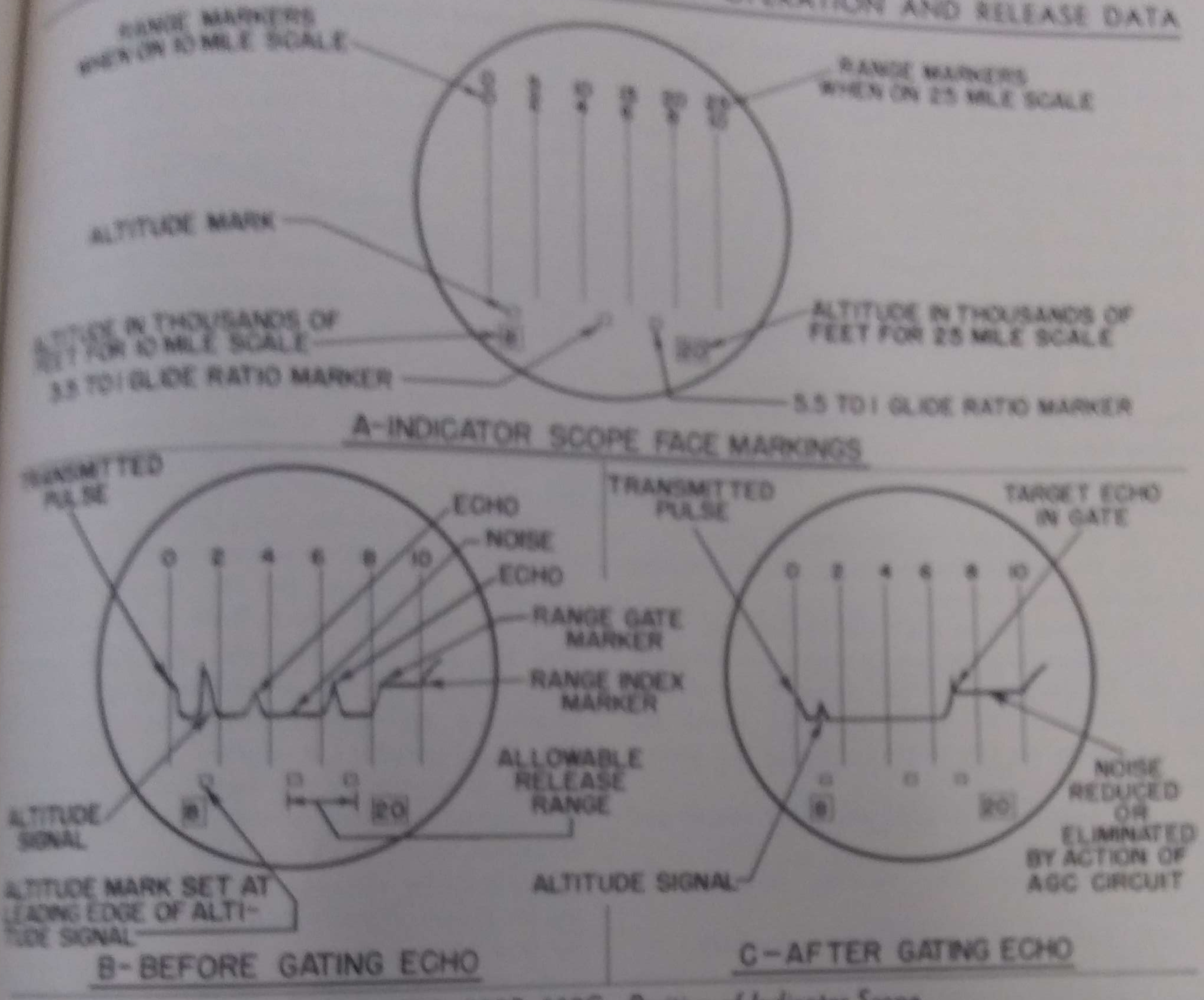
RANGE MARKERS WHEN ON 10 MILE SCALE
0
2
4
6
8
10
0
5
10
15
20
25
RANGE MARKERS WHEN ON 25 MILE SCALE
ALTITUDE MARK
ALTITUDE IN THOUSANDS OF FEET FOR 10 MILE SCALE
8
20
ALTITUDE IN THOUSANDS OF FEET FOR 25 MILE SCALE
3.5 TO 1 GLIDE RATIO MARKER
5.5 TO 1 GLIDE RATIO MARKER
A-INDICATOR SCOPE FACE MARKINGS
TRANSMITTED PULSE
ECHO
NOISE
ECHO
RANGE GATE MARKER
RANGE INDEX MARKER
ALLOWABLE RELEASE RANGE
ALTITUDE SIGNAL
ALTITUDE MARK SET AT LEADING EDGE OF ALTITUDE SIGNAL
B-BEFORE GATING ECHO
TRANSMITTED PULSE
TARGET ECHO IN GATE
NOISE REDUCED OR ELIMINATED BY ACTION OF AGC CIRCUIT
ALTITUDE SIGNAL
C-AFTER GATING ECHO

Figures 118A, 118B, 118C—Position of Indicator Scope.

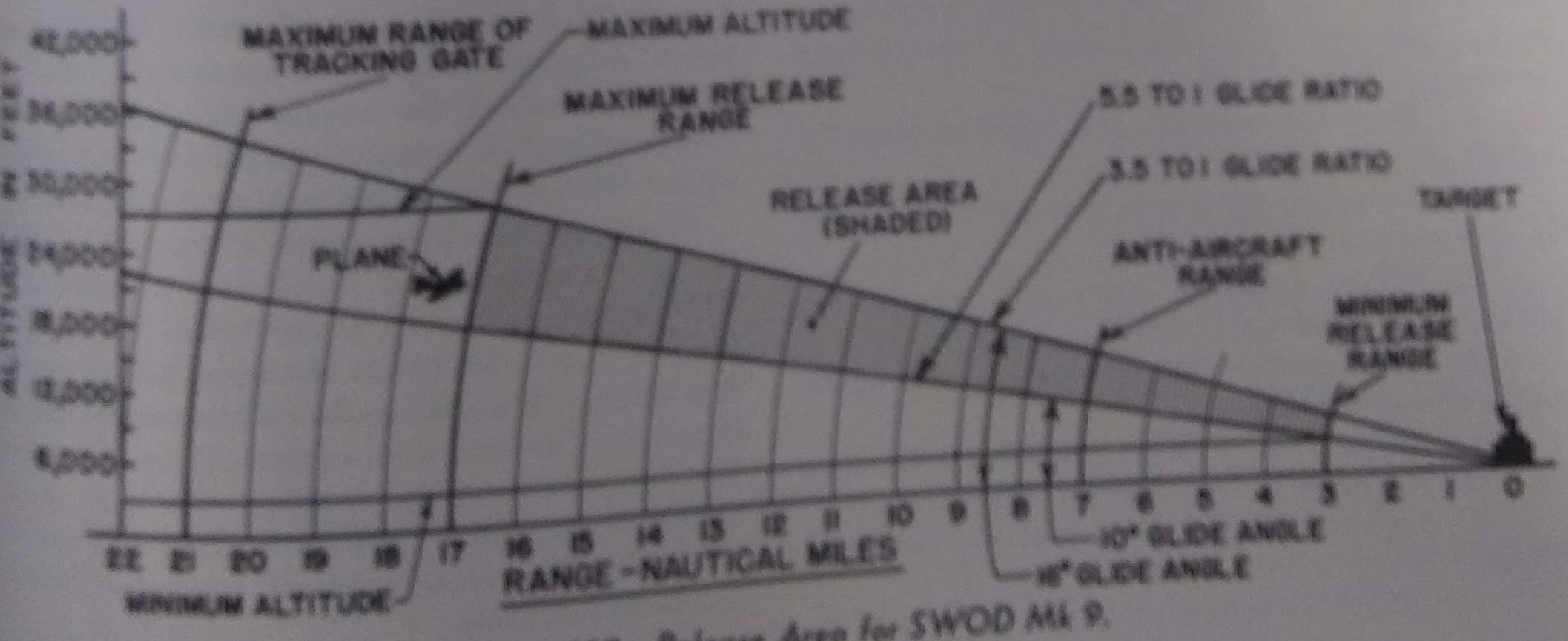

Figure 119—Release Area for SWOD Mk 9.

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(4) In cooperation with the pilot decide the best course for attack.

(5) Make sure that the selected course will separate the targets by 300 yards in range. **Note:** If a course is selected such that the targets are at the same range, they will appear on the BAT scope as one target and the BAT will not be able to discriminate between them.

(6) Indicate to the BAT operator via the SWOD (Coordinator) Mk 9 which target has been selected for attack.

PILOT: The pilot must cooperate with the search operator and the BAT operator in the following manner:

(1) Maneuver the plane into position for the attack.

(2) Visually identify the target if possible.

(3) Determine the dropping altitude within the missile characteristics.

(4) Decide which BAT will be dropped first.

(5) Allow for sufficient on-course time in preparation for dropping. (Time depends on skill of BAT operator.) If target is visual, check the cross-pointers on the indicator meter for proper response.

(6) Maintain a straight and level course and speed.

(7) Coordinate the various functions of dropping.

(8) Take evasive action when necessary.

BAT OPERATOR: After the target has been located and the aircraft is directed toward it, the BAT operator then comes into the picture. His duties begin even before take-off by checking to make sure that his equipment is functioning properly. Other functions are:

(1) Have the radar on and checked properly before on-course flight.

(2) Cooperate with search operator and pilot in obtaining target information.

(3) Figure dropping ratio and range for given altitude and notify pilot.

(4) Do all necessary functions for locking on and tracking the target.

(5) Notify pilot of range and AVC indication at given intervals as the target is approached.

(6) Activate the release mechanism for BAT release.

b. General Information

The SWOD Mk 9 equipment is turned on and allowed to warm up for about ten minutes, and then a complete functional check is made by using the altitude signal as a target. This is done prior to entering any area where the use of this weapon is possible or probable.

Search for targets is normally conducted on a standard APS–15 search radar. However, the BAT is valuable also as a search equipment in case of necessity.

Operation is normally on plane power supply during search. The units are not switched to glider power until attack is certain. A fully charged set of glider batteries can be relied upon for only about 25 minutes of operation.

After the target has been located by the search operator and when attack is ordered by the pilot, the plane is headed for the target. After the pilot has specified which BAT is to be launched and the launching altitude, the BAT operator then determines the launching range and performs the preliminary switching. The SWOD Mk 9 equipment is shifted to glider power tuning is accurately checked and the equipmen is returned to plane power. The target is the identified to the BAT operator through the rang coordinator by the search operator, who is checking for proper identity, size, range, and its proximity to other targets.

As soon as the BAT operator knows which the desired target, he locks on and observ AVC action to determine accurate tracking. H then notifies the pilot "BAT locked on the targ at (a certain) range and tracking." As th continue toward the target the BAT operat checks over his complete readiness and repor to the pilot ranges every mile or half a mile.

When the dropping point is reached the BA operator makes a last check of the "AVC" a "Tracking" to assure himself that he is on t desired target, and that the appropriate "read light is lit. This means that all necessary switch have been thrown and everything is in readin for the release of the missile. The unit is th released by the BAT operator. Figure 1 shows a BAT being released from an SB2C- for test purposes.

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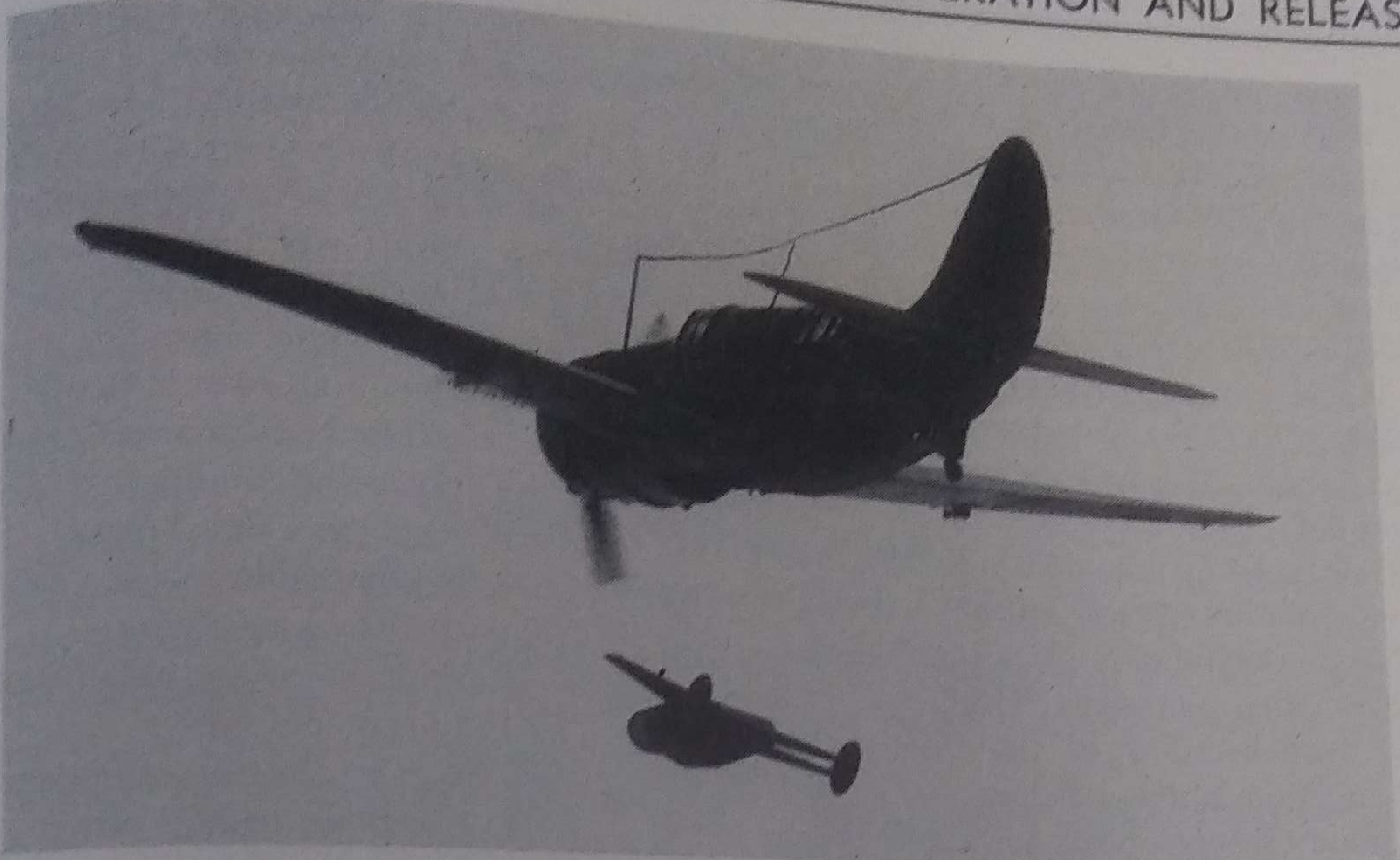

Figure 120—BAT Being Released From SB2C–1C

When units are to be released in salvo it is recommended that a minimum delay of 3 seconds be used between units. However, they have been successfully launched with a very slight delay. Close formation flights of units could result in collisions between units. A 3-second delay would allow adequate spacing.

The BAT will complete a normal attack under zero wind conditions when released from 5,000 feet and at a 5 to 1 glide ratio in from 60 to 72 seconds. This is directly proportional from other altitudes for 5 to 1 glide ratio flights.

c. Launching Procedures

BAT OPERATOR: The BAT operator must master the following procedure for successful launching of the missile. None of the steps given below should be neglected during standby, approach, or attack.

(1) *Standby:*
  (a) Preliminary:
    1. Indicator switch to ON.
    2. Connection Box Mk 5 (Junction Box J–233) switch to ON.
    3. Control switch to "A". This switch and the following ones under standby are on the Control Unit (Control Monitor C–437/APA–66) of the monitor.
    4. Power Switch to PL. Check plane meters. Check AVC meter. Wait three minutes.
  (b) Tuning check (tuning key):
    1. Spinner switch to ON.
    2. Power switch to PL and TRANS. Maximize altitude signal.
    3. Power switch to READY. Check that tuning remains unchanged.
    4. Power switch to PL and TRANS.
  (c) Slewing check (slew switch to A; use slewing knob)
    1. Check maximum range.
    2. Slew on altitude signal. Slew switch to TRACK. Pilots transfer switch to "A". Power switch to READY.
    3. Check indicators and ready lights. Power switch to PL and spinner switch to OFF (standby).

(2) *Approach:*
  (a) Control unit (Control Monitor C–437/APA–66)
    1. Power switch to PL and TRANS.
    2. Spinner switch to ON.
    3. Slew switch to "A".
    4. Pilots transfer switch to "A".
    5. Altitude knob to launching altitude (announce launching range to pilot).

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(b) Armament switch box.

1. Port arming switch to ON.

2. Port selector switch to ON. Master switch uncovered.

(3) *Attack:*

(a) Slew on target.

1. Slew switch to TRACK.

2. Power switch to READY.

(b) Check AVC ready lights and response (announce "Locked on and tracking" to pilot).

1. Call range at mile and half-mile intervals.

2. Master switch ON (pickle in hand).

3. Fire when pilot says "OK".

Pilot: The responsibility of the pilot before and during launching is given below.

(1) The pilot's responsibility for a unit begins when it is hung on the plane.

(a) He must pass on whether it is safely and properly hung; major points are:

1. Unit level with the ground.

2. Elevons neutral.

3. Sway braces safetied.

4. Bomb arming wires installed.

5. Servo arming wire connected.

(b) He must satisfy himself that the preflight acceptance check has been properly made by one of his flight crew and that the check sheets have been completed, signed and filed.

(2) The pilot is final judge in whether or not a unit is fit to be dropped.

(a) By observing his cross-pointer indicator while maneuvering the aircraft, he must pass on whether or not the intelligence is correct and sensitivity is satisfactory. Major points are:

1. Unit on PL or not locked on. Static balance OK. Bias gyro response (Mod 0) shows that feedback signal during turn is constant (Left indication during right turn and vice-versa).

2. Unit locked on: Directional sense OK. Directional sensitivity OK. Different for Mod 0 and Mod 1 (varies slightly between units of same type). The values for 3° and 6° should be recorded in terms of dots on the meter. The pitch is about double yaw.

(b) The following points may be checked with the aid of the operator:

1. Range switch (Mod 0 only). Track altitude signal and *descend* until switch fires (about 2000′). The firing point will be recognized by a sudden increase in cross-pointer deflection. This value should be recorded. Check that bias gyro in item 1 above has no effect while switch is fired.

2. Gyro functioning (Mod 1 only). Uncage gyro (level flight). Note time to uncage and recage. Note elevon flutter while uncaging.

(3) The pilot is responsible for proper launching. The requirements are:

(a) Proper selection of course.

1. Clear sector and range.

2. Upwind course if feasible.

3. Quartering on stern (high speed target).

(b) Proper identification of target. Check against indicator as in sensitivity check.

(c) Proper release speed and altitude.

3. ATTITUDE OF SWOD MK 9 (BAT) AND PARENT PLANE AT TIME OF RELEASE

The parent plane should be straight and level for the last five seconds of the time that the SWOD Mk 9 is being readied for release. This permits the BAT to drop away normally on its glide path. The dropping aircraft should also be headed directly toward the target in azimuth, within ±5 degrees, as indicated by the pilot's directional meter.

The SWOD Mk 9 is hung so that the chord line of the wing of the air stabilizer is parallel to the chord line of the wing of the carrying aircraft. In normal cruising flight attitude the chord line of the wing of the plane is at a small angle above the horizontal. This angle of attack varies with different types of aircraft and on each one depends upon such factors as the camber of the wing, speed, loading, etc.

The chord line of the wing of the BAT is parallel with the axis of the air stabilizer. After release, the BAT has a normal and fairly constant angle of attack of a given number of degrees depending

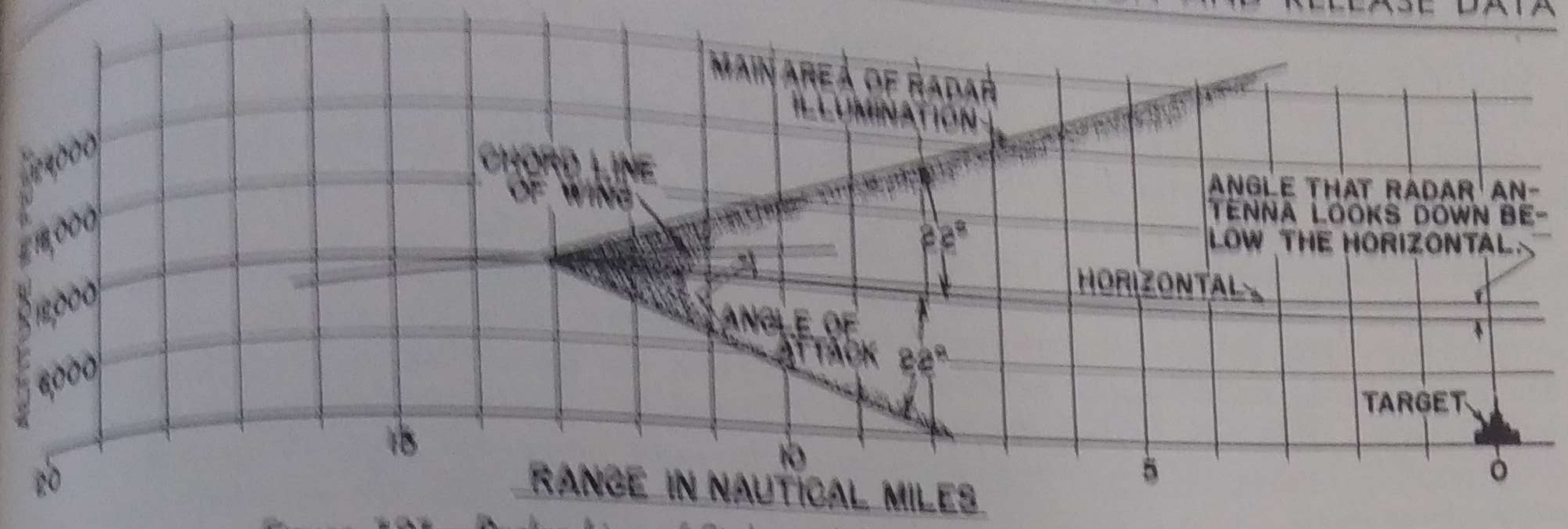

Figure 121—Radar Line-of-Sight with Plane in Normal Cruising Altitude.

various conditions. This angle of attack is compensated for in the radar unit by placing the axis of the radar antenna the same number of degrees as the angle of attack below the axis of the air stabilizer. Thus, due to the angle of attack with the parent plane in normal flight the radar antenna is "looking" down a small amount from the horizontal or from the normal flight path of the aircraft. See Figure 121.

The pilot's directional meter will, therefore, normally show a "down" indication at the time of release. Naturally, if the plane were flying in a nose down attitude with the radar antenna line of sight below the target, the directional meter would give an "up" indication. After release, as the BAT stabilizes on its glide path the radar line of sight centers on the target.

4. LAUNCHING SPEEDS

The SWOD Mk 9 should be released from the parent plane at a speed within the lower portion of its range of flying speeds. Upon release under these conditions it should drop away from the aircraft and fall momentarily behind and below while gaining flying speed.

The indicated air speed at the time of release should be between 140 and 210 knots; however, speeds between 180 and 200 knots are much more preferable. If the speed at the time of release is less than 140 knots the BAT will rapidly lose altitude in attaining flying speed. This loss in altitude may carry the unit below the 5½ to 1 glide ratio before stable flying speed is attained, thus reducing the glide angle below a satisfactory operating value. This may cause a "nosing down" of the missile during the time that it is gaining flying speed which in turn would point the antenna beam far enough away from the target that radar tracking is lost.

Launching the missile at speeds higher than 210 knots may prove hazardous as the unit might not drop away from the aircraft in a normal manner. Release at high speeds may cause the BAT to cling to the release mechanism or to gain altitude when disengaged.

5. SELECTING THE ANGLE OF APPROACH

a. Isolated Targets

It is desirable that the SWOD Mk 9 be released toward the target under as favorable conditions as the situation warrants. Because of the relatively large radius of turn imposed on the BAT by the gyro stabilization system employed, a course involving the minimum of correction in the direct flight path is preferred. An approach to the target that exposes the largest projected area is advantageous both from the standpoint of greater returning radar echo and larger target area.

The two principal factors affecting the homing flight of the missile are the speed and direction of the wind, and the speed and course of the target. Wind and target motion may be disregarded when either or both are questionable or unknown. However, they should not be disregarded if it is at all possible to take them into consideration.

A quick rule of thumb method for selecting an advantageous angle of attack under known wind conditions is to release the BAT from a position between 135° and 225° relative to the wind; a course into the wind.

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To attack moving sea targets under conditions such that the speed and direction of the wind and the speed and course of the target may be estimated with fair accuracy, the BAT should be released from such a direction that the bearing of the point of release will be between 135° and 225° from the relative motion line between the target and the wind. This is illustrated in Figure 122.

The above considerations apply for attacks on isolated targets. However, for attacks involving several possible targets the range consideration becomes paramount.

b. Multiple Targets

The movable range gate of the radar unit is so designed that target echoes received at the time of the gate will pass through the radar unit and provide directional control information. All other echoes are excluded and have no effect upon the directional control of the BAT. This range gate provides a selection in range such that targets separated by approximately 300 yards may be selected after which the radar equipment may be adjusted for automatic tracking on the selected target.

For multiple targets the angle of approach should be chosen so that the selected target is separated in range by a minimum of 300 yards from other possible targets. Figure 123 illustrates a desirable angle of approach on a small force.

Should the approach angle be such that two or more targets are within the 300-yard movable range gate the tracking would be affected by the returning echoes from all the targets within the range gate. Thus homing on one target would be adversely affected although the BAT would probably attempt to home on the target returning the largest radar echo.

Attacks on multiple targets should be closely coordinated with the search radar operator to obtain the proper target azimuth discrimination. If two or more targets appear at approximately the same range, the angle of approach should be chosen so that only the selected target will be within the 300-yard movable range gate.

6. LAND TARGETS

a. General

The SWOD Mk 9 is not an effective missile for use against land targets. This conclusion was reached after many tests and surveys were made for the purpose of evaluating its effectiveness against such targets. The radar intelligence is not sufficiently selective to be preset on any one target in a group or on any isolated target where land formations may also give strong returns.

It is possible to make definite hits on isolated dams, bridges and certain large isolated land installations. However, approximately five times as much training is required for both pilots and operators as is required for standard usage over water.

The best form of reconnaisance prior to using SWOD Mk 9 equipment over land is familiariza-

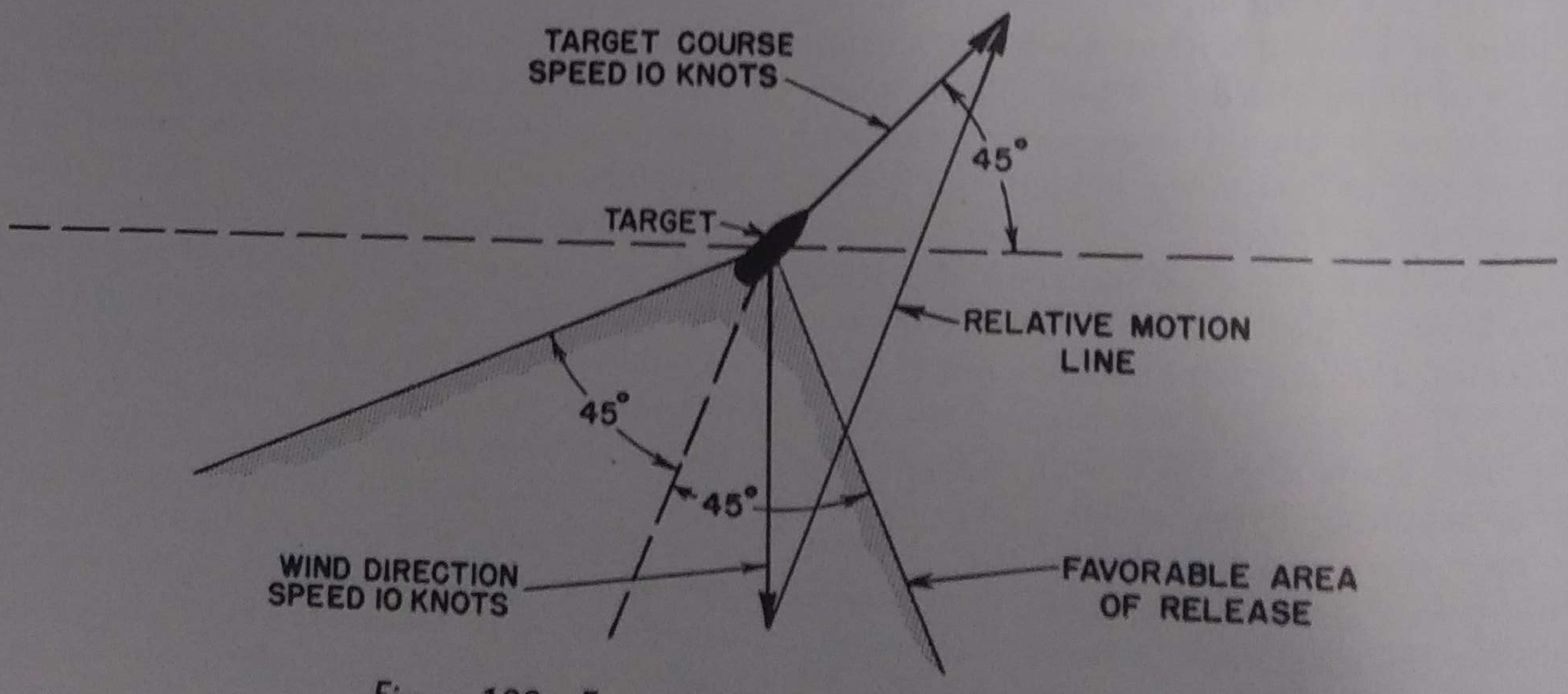

Figure 122—Favorable Area of Release for BAT.

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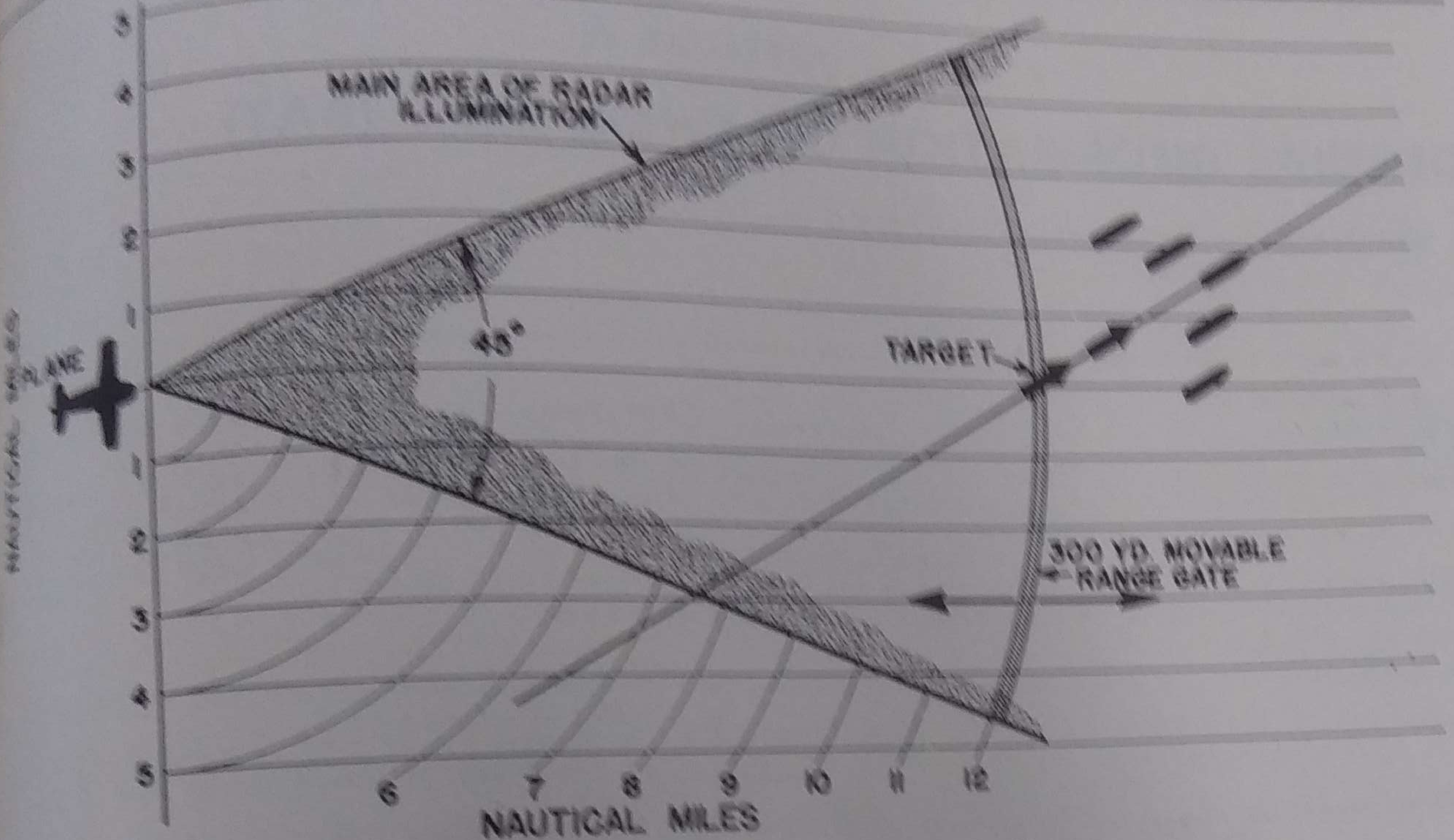

Figure 123—Angle of Approach on Multiple Targets.

ion with the “S” band “A” scope presentation. Standard aircraft search equipment does not supply the required information.

b. Prerequisites For Successful Use Over Land

The following outline gives the prerequisites for successful use of the BAT over land.

(1) For best results with SWOD Mk 9 equipment over land:

(a) Experienced personnel, both pilot and operator.

(b) Isolated target which gives a strong steady signal from 10 miles and is 2 miles from any equal or stronger signal.

(c) Expanded sweep for accurate gating (not used at present).

(2) To make a definite hit over water surrounded by land:

(a) Experienced personnel, both pilot, and operator.

(b) Target over water must be isolated by ½ mile from targets of equal or greater strength.

(c) Expanded sweep for accurate gating. (Not incorporated in the present system.)

(d) Previous knowledge of the appearance of the area shown on the “A” scope.

(3) In both cases: Runs must be made from ample range to allow careful checking of both vertical and horizontal needles of the indicator meter before dropping. This should be in the nature of 1½ minutes in time or 4 miles when making 180 knots.

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APPENDIX A

GENERAL INFORMATION ON SWOD MK 9 (BAT)

a. Unit Designation For Complete SWOD Mk 9 Mod 0 System

	Single Channel	Double Channel	Triple Channel
Plane Equipment			
Pilot Indicator	CAY-22446	CAY-22446	Mk 16 Mod 1 (ID-230/APA-65).
Monitor	Mk 3 Mod 0 (Control Group AN/APA-67).	Mk 2 Mod 2 (Control Group AN/APA-66).	Mk 2 Mod 1 (Control Group AN/APA-65).
AVC Battery Voltage Ind.	MX/Mk 3 (AVC) (Voltmeter TS-632/APA-67).	(Built in Monitor)	MX/Mk 2 (AVC) (Voltmeter TS-631/APA-65).
Release Box	Test Unit Mk 31 Mod 0	Armament Switch Box	
Wing J. B.	A component of NAMU plane modification.		
SWOD Mk 9 Mod 0			
Air Stabilizer		SWOD (Air Stabilizer) Mk 13 Mod 0 (List 10 with Tail Elevator Modification).	
Radar		SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) (List 1 or 2 with Minimum Range Mod. & Diff. Amp. Mod.).	
Power Supply		SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP-284/DPN-1) (List 1 or 2).	
Invertor		A component of SWOD (Power Supply) Mk 16 Mod 1 (List 1 or 2).	
Gyro Panel		SWOD (Gyro Panel) Mk 6 Mod 1 (List 1 or 2) Gyroscope Assembly CN-73/DPN-1.	
Servo		SWOD (Servo) Mk 4 Mod 4 (Flight Control Servo PU-145/DPN-1) (Packed with List 10).	
Payload		AN-M65.	
Batteries		3—14-volt (7-TAS-9E) (List 18).	
Electrolyte (3 gal.)		For 7-TAS-9E Batteries (List 9).	
Fuzes (Front)		Mk 235 (List 11).	
Fuzes (Rear)		Mk 236 (List 11).	

b. Unit Designation For Complete SWOD MK 9 Mod 1 System

Plane Equipment			
Pilot Indicator	CAY-22446	CAY-22446	Mk 16 Mod 1 (ID 230/APA-65).
Monitor	Mk 3 Mod 0 (Control Group AN/APA-67).	Mk 2 Mod 2 (Control Group AN/APA-66).	Mk 2 Mod 1 (Control Group AN/APA-65).
AVC Battery Voltage Ind.	MX/Mk 3 (AVC) (Voltmeter TS-632/APA-67).	(Built in Monitor)	MX/Mk 2 (Voltmeter TS-631/APA-65) (AVC).
Wing J. B.	A component of NAMU plane modification		
Release Box	Test Unit Mk 31 Mod 0	Armament Switch Box	
SWOD Mk 9 Mod 1			
Air Stabilizer		SWOD (Air Stabilizer) Mk 13 Mod 1 (List 10 less servo with Fuselage Modification Kit incorporated).	
Radar		SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2) (List 25 with Minimum Range Mod. and Directional Control Amplifier Mod.).	
Power Supply		SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP-285/DPN-2) (List 26 with Power Supply Mod.).	
Invertor		A component of SWOD (Power Supply) Mk 16 Mod 2 (List 27).	
Servo		SWOD (Control System) Mk 18 Mod 0 or 1 (Flight Control Servo PU-146/DPN-2).	
Payload		AN-M65.	
Batteries		3—14-volt (7-TAS-9E) (List 18).	
Electrolyte (3 gal.)		For 7-TAS-9E Batteries (List 9).	
Fuzes (Front)		Mk 235 (List 11).	
Fuzes (Rear)		Mk 236 (List 11).	

Modification Kits, and Spare Parts Kits

Description	Quan.	Contract	Contractor
Minimum Range Modification Kit	2, 870	NOrd 9814	Lewyt Corp., 60 Broadway, Brooklyn, N. Y.
Spares for Minimum Range Mod. Kit	145	NOrd 9814	Lewyt Corp., 60 Broadway, Brooklyn, N. Y.
Differential Amplifier Modification Kit	1, 750	NOrd 9828	Wash. Inst. of Tech., College Pk, Md.
Spares for Diff. Ampl. Mod. Kit	85	NOrd 9828	Wash. Inst. of Tech., College Pk, Md.
Auxiliary Tail Elevator Mod. Kit	1, 650	NOrd 9898	Geo. Leland Development Co., Dayton, O.
Directional Control Amp. Mod. Kit	1, 000	NOrd 9840	Televiso Products Co., Chicago, Ill.
Spares for Directional Control Amp. Mod. Kit.	50	NOrd 9840	Televiso Products Co., Chicago, Ill.
Power Supply Modification Kit	1, 000	NOrd 9840	Televiso Products Co., Chicago, Ill.
Spares for Power Supply Mod. Kit	50	NOrd 9840	Televiso Products Co., Chicago, Ill.
Fuselage Modification Kit	1, 050	NOrd 9762	Camden Eastern Marine Co., Camden, N. J.
SWOD (Control System) Mk 18 Mod. 1	990	NOrd 8142	Western Elec. Co., 120 Broadway, N. Y. C.
Spares for SWOD (Control System) Mk 18 Mod. 1.	10	NOrd 8142	Western Elec. Co., 120 Broadway, N. Y. C.

Note: It will be noted that spares are not provided on items 5 and 10. These items are essentially direct installations with no particular future service requirement. If replacements are needed the original modification kit should be used. A sufficient quantity of overage has been provided.

Key To List Number Packaging System (Components of List Numbers)

List No.	Components of List Numbers: Contents Per Shipping Case	Marking on Case	Number of Cases for 48 Units	Classification
1	MASTER SHIPPING CASE (a) SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1). (b) SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP-284/DPN-1). (c) SWOD (Gyro Panel) Mk 6 Mod 1 (Gyroscope Assembly CN-75/DPN-1). (d) 3 Batteries (7-TAS-9E). (e) Cables for items (a), (b), and (c).	SWOD Mk 9 Mod 0 List No. 1	32	Confidential.
2	MASTER SHIPPING case WITH OPERATING SPARES. Same as List 1 except includes 1 Set Operating Spares for SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) & SWOD (Power Supply) Mk 16 Mod 1 (PP-284/DPN-1)	SWOD Mk 9 Mod 0 List No. 2.	16	Confidential.
3, 4, 5, 6, 7, 8, 19, 21, 22 & 23.	BULK SPARES Western Electric Co.	SWOD Mk 9 Mod 0 List No. 3. (10 boxes per a set, each box marked with list number marked thereon.)	1	Confidential.
	(a) Radar Bulk Spares		160	Unclassified.
9	ELECTROLYTE SHIPPING CASE. (a) 1 gal. Carboy of Sulfuric Acid Electrolyte	SWOD Mk 9 Mod 0 List No. 9.	48	Restricted
10	IR STABILIZER SHIPPING CASE (a) SWOD (Air Stabilizer) Mk 13 Mod 0 — *Old Type (150)* Mk 4/0 *(c) Nose Fuse Coupling — Mk 5/0 (d) Tail Fuse Coupling — Mk 6/0 (e) Destructor Coupling (f) 2 Double Arming Wires (g) Fahnestock Clips	SWOD Mk 9 Mod 0 List No. 10 *New Type* Mk 4/1 Aldon Mk 5/1 Aldon Mk 6/1 Aldon {to be shipped in List No. 11 beginning after ser. No. 1000.		

*There is no item (b).

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COMPONENTS OF LIST NUMBERS (CONT'D)

List No.	Contents Per Shipping Case	Marking on Case	Number of Cases for 48 Units	Classification
	(h) SWOD (Serve) Mk 4			
	NOTE: List 10 marked "Less Servo" do not include item h.			
11	FUZE SHIPPING CASE	SWOD Mk 9 Mod 0 List No. 11.	16	Restricted.
	(a) 3 Nose Fuzes Mk 235.			
	(b) 3 Tail Fuzes Mk 236.			
	(c) 3 Nose Fuze Arming Vanes	Arming Vane & Gear Assembly Mk 1 Mod 0. (All three are alike.)		
	(d) 3 Tail Fuze Arming Vanes			
	(e) 3 Destructor Arming Vanes			
	(f) 1 Roll ½" Friction Tape.			
16	SPARE PARTS SHIPPING CASE	SWOD Mk 9 Mod 0 List No. 16.	1	Restricted.
	(a) SWOD (Servo) Mark 4 (Flight Control Servo PU–146/DPN–2). Spare Parts.			
17	SPARE GYROS SHIPPING CASE	SWOD Mk 9 Mod 0 List No. 17.	1	Restricted.
	(a) 10 Pitch Gyros.			
	(b) 5 Bias Gyros.			
	(c) 5 Venturi tubes.			
	(d) 5 Gyro Filter Panels.			
	(e) 1 Search Chamber.			
	(f) 6 Compression Nuts.			
	(g) 2 Elbows.			
	(h) 2 AN–3102–22–17P Connectors.			
	(i) 2 AN–3102–22–19P Connectors.			
	(j) 3 feet ¼ inch Copper Tubing.			
18	SPARE BATTERIES SHIPPING CASE	SWOD Mk 9 MOD 0 List No. 18.	5	Unclassified.
	(a) 3 Batteries per case Type 7—TAS—9E.			
	NOTE: The fourth column "No. of Cases for 48 Units" is inserted to show the proportionate no. of cases required for each List No. when 48 SWOD Mk 9 Mod 0 are to be shipped overseas. The figure, 48, is for demonstration purposes only and does not indicate shipments will be requested in lots of 48 SWOD Mk 9 Mod 0.			
19	(Extra) NOSE SECTIONS	SWOD Mk 9 MOD 0 (List No. 19).		
	Bulk spare nose sections for SWOD (Radar) Mk 2 Extra List 19 in small box contains 2 nose sections. Extra List 19 in large box contains 5 nose sections.		Extra	Restricted.
25	SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN–1) (as delivered by the contractor).	SWOD Mk 9 MOD 0 List No. 25.	1	Confidential.
26	SWOD (Power Supply) Mk 16 Mod 1 (Power Supply PP–284/DPN–1) (as delivered by the contractor).	SWOD Mk 9 MOD 0 List No. 26.	1	Confidential.
27	Inverter (Eclipse 800–1–D) for use with List 26	SWOD Mk 9 Mod 0 List No. 27.	1	Unclassified.
28	Operating Spares for SWOD (Radar) Mk 2 Mod 1 & SWOD (Power Supply) Mk 16 Mod 1.	SWOD Mk 9 MOD 0 List No. 28.	1	Confidential.
103	TOOLS SHIPPING CASE	SWOD Mk 9 MOD 0 List No. 103.	1	Restricted.
	(a) 1 Set Carpenter Tools.			
	(b) 4 Sets Ordnance Tools.			
	(c) 2 Chain Hoists.			
	(d) 1 Set General Work Tools.			
120	Plane Modification Kits	SWOD Mk 9 MOD 0 List 120	No quantity	Confidential.
	All necessary items for modification of plane as per N. A. M. U. Project TED–NAM–1832.			

Numeral System of Electrical Component Designation

Number Series Assigned	Section of Equipment	Number Series Assigned	Section of Equipment
100	Low Voltage Power Supply.	1200	BV Indicator.
200	Target Selector.	1300	Plane Junction Box.
300	Direction Control & A. G. C.	1400	Control Unit.
400	I. F. Strip.	1500	Antennae Assembly.
500	Pre I. F. Strip.	1600	Gondola Junction Box.
600	Transmitter.	1700	Rack.
700	High Voltage Supply.	1800	Range Switch.
800	Inverter—Reg Rec Plugs and Relays.	1900	Western Elec. Servo.
900	Indicator.	2000	Directional Control Amp.
1000	Pilot's Indicator.	2100	Servo Power Unit.
1100	Beating Oscillator.		

Outline of Major Modification Kits

(A) MODIFICATIONS WHICH MUST BE APPLIED TO ALL EXISTING SWOD MK 9 EQUIPMENTS.
- (1) Minimum Range Mod Kit.
  - (a) Containers Marked: For SWOD Mk 9.
  - (b) Modified Component: SWOD Mk 2 Mod 1 or Mod 2 (Radar Set AN/DPN–1 or 2).
  - (c) Chassis Marked: MIN RANGE PRE IF Serial ———.

(B) MODIFICATIONS NECESSARY FOR MODERNIZING THE SWOD MK 9 MOD 0 USING THE SWOD SERVO MK 4 (PU–145/DPN–1).
- (1) Auxiliary Tail Elevator Mod Kit.
  - (a) Containers Marked: For SWOD Mk 9 Mod 0.
  - (b) Modified Component: SWOD Mk 13 Mod 0.
- (2) Differential Amplifier Mod Kit.
  - (a) Containers Marked: For SWOD Mk 9 Mod 0.
  - (b) Modified Component: SWOD Mk 2 Mod 1 (Radar Set AN/DPN–1).
  - (c) Chassis Marked: DIFFERENTIAL AMPLIFIER UNIT Serial ———.

(C) MODIFICATIONS FOR CONVERTING SWOD MK 9 FROM MOD 0 TO MOD 1, INCORPORATING THE SWOD SERVO MK 18.
- (1) Directional Control Amplifier Mod Kit.
  - (a) Containers Marked: For converting SWOD Mk 9 Mod 0 to Mod 1.
  - (b) Modified Component: SWOD Mk 2 Mod 2 (Radar Set AN/DPN–2).
  - (c) Housing Marked: DIRECTIONAL CONTROL AMPLIFIER UNIT Serial ———.
- (2) Power Supply Mod Kit.
  - (a) Containers Marked: For converting SWOD Mk 9 Mod 0 to Mod 1.
  - (b) Modified Component: SWOD Mk 16 Mod 2 (Power Supply PP–285/DPN–2).
  - (c) Chassis Marked: SERVO POWER UNIT Serial ———.
- (3) Fuselage Mod Kit.
  - (a) Containers Marked: For converting SWOD (Mk 9 Mod 0 to Mod 1.
  - (b) Modified Component: SWOD Mk 13 Mod 1

NOTE: Modified 8/14/46. Item (C) (3) eliminated.
Item (C) (4) changed to (C) (3).
Previous (C) (3) will be part of revised (C) (3).

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8. General Index of Information and Disposition of SWOD (Radar) Mk 9 Mod 1 (Radar Set AN/DPN-1) Modifications Instituted by Manufacturer and/or Navy

Part No.	From—	To—	Change No.	Serial No.	Recommendations
(1) Low Voltage Power Supply:					
R-141	.47 M	33 K	None	None	Must be accomplished in all units to stabilize—200 volts. Revision to new value covered in OP688 (First Rev.), Appendix, Section I-A & II-A.
(2) Target Selector:					
C-207		add	117	30	Information only (r f bypass).
R-231		1Meg	232	209	Information only.
C-208A	C-204A	C-208A	260	377	Information only.
R-205		add	260	377	Information only (decouples V-203B).
C-208B		add	260	377	Information only (decouples V-203B).
R-230	27 K	6.8 K	314	126	Information only (stabilizes range).
V-208	6SL7	6SN7	123	Unknown	Use latter when replacement required.
C-209		add	525	271	Remove from all units. OP688 (First Rev.), Appendix, Section I-A, automatically removes this item.
C-203	C-260	added	718	Unknown	All units must have 2400 uufd between pins 1 and 5 of V-203 to give 21 mile range.
C-203	C-260	out			This series of changes was for that purpose.
	1500	2000	71281	Unknown	
C-203	2000	2400	803	2336 (est)	
C-206A	C-206	C-206A	826	Unknown	Added to eliminate interaction in gate bias adjustments. Do not incorporate.
C-206B		add	826	Unknown	
R-240	1.5K	620	826	Unknown	Divider modification to increase range of gate bias adjustments. Observe effects of Change 826 but do not incorporate.
R-244	68K	20 K	826	Unknown	
R-246	39 K	12 K	826	Unknown	
R-296		add	966	None	Stabilizes delay multivibrator. Not to be added.
R-297		add	966	None	
C-299		add	966	None	Same—do not confuse with C-203 Mod.
R-338		Select	72	209	Information only (for balance).
R-339		Select	72	209	Information only (for balance).
(3) Directional Control Unit and A. V. C.:					
R-338	Select	Remove	72	209	Information only (for balance).
R-339	Select	Remove	72	209	Information only (for balance).
R-333		add	72	209	Information only (for balance).
R-334		add	72	209	Information only (for balance).
R-328	.27M	.20M	72	209	Information only (for balance).
R-329	.27M	.20M	72	209	Information only (for balance).
R-320		Select		209	Information only (for balance).
R-320	Select	.1M Pot	74	209	Information only (for balance).
C-326	1.0mf	.5 mf	80	190	Information only (speed AVC action).
C-328		add	283	131-141, 145-3150.	Information only (filter 6.3 volts).
R-333	TapU	TapD	510	236	Information only (improve ckt. eng.).
R-334	TapU	TapD	510	236	Information only (improve ckt. eng.).
R-337	1.0M	.68 M	510	236	Information only (improve ckt. eng.).
R-341	.1 M	82 K	516	330	Information only (increase threshold range).
R-324	10 K	9.1 K	519	*261	Information only.
R-330	10 K	9.1 K	519	261	Information only.
P-1501	P-301	P-1501	540	530	Information only (Corrects designation).
C-329		add	602	431	Should be found on all units, but due to variation remount per OP 688 (First Rev.), Appendix—Section I-A & II-A.

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a. General Index of Information and Disposition of SWOD (Radar) Mk 2 Mod 1 (Radar Set AN/DPN-1) Modifications Instituted by Manufacturer and/or Navy

PART NO.	FROM—	TO—	CHANGE NO.	SERIAL NO.	RECOMMENDATIONS
[illegible]	1.0 M	Rewire	735	1001	Modification for installation of Range Switch.
[illegible]	.68 M	Rewire	735	1001	Installation of OP 688 (First Rev.), Appendix—Section I-B or II-B automatically takes care of requirement.
[illegible]		Added	735	1001	
[illegible]	6AC7	6AC7W	814	1100	Use to stabilize AVC circuit.
[illegible]	.68 M	.30 M	820	Unkn	Information only (increases AVC gain).
[illegible]	.20 M	.18 M	960	None	Information only.
[illegible]	.20 M	.18 M	960	None	Information only.
R-316	500	2 K		None	Increase bias range. Change should be made on all systems. Instructions for revision in "Maintenance Chapter of System Manual." Revised adjustment procedure must be followed.

(4) Intermediate Frequency Amplifier Strip:

PART NO.	FROM—	TO—	CHANGE NO.	SERIAL NO.	RECOMMENDATIONS
C-409	C-419	C-409	275	36	To correct designation.
C-4	360	500	416	330	Information only (all bypass Condensers).
C-4	50	30 or 51	685	1000	Information only (ease in procurement).

Also all units must contain changes of Minimum Range Modification of OP688 (First Rev.), Appendix—Sections I-A and II-A.

(5) Pre I. F. Amplifier: Must be replaced in all units per Minimum Range Modification of OP688 (First Rev.), Appendix—Sections I-A and II-A.

(6) Transmitter:

PART NO.	FROM—	TO—	CHANGE NO.	SERIAL NO.	RECOMMENDATIONS
V-603	1437	1B29	99	101	Information only.
V-604	1437	1B29	99	101	Information only.
R-611	75	47	202	101	Information only.
V-606	721A	721B	726	957	Information only.
V-606	721B	1B62		None	Must change on all units per OP688 (First Rev.), Appendix—Section I-A and II-A.
P-602	P-502	P-602	758	2085	Information only (correct designation).
P-1101	P-601	P-1101	758	2085	Information only (correct designation).
R-611	P-603	Mixer	758	2085	Follow instructions included with replacement mixers regarding proper termination.
BO-30611-L (Shell assembly)			None	None	New magnetron chuck (shell assemblies) must be installed.

(7) High Voltage Power Supply: No changes required in this component.

(8) Power Supply Control Circuits and Inverter: Note correction of designations on K-801 and K-802 to agree with actual part marking. Note changes to be applied with Power Supply modification of OP688 (First Rev.), Appendix—Section II-C.

(11) Beating Oscillator. NOTE: The beating oscillator was completely replaced with a new pressurized beating oscillator by change number 862 on units starting with serial number 3051. Field Change Kit 1-2 must be applied to all sets with a lower serial number—see the inspection section of the manual.

(14) Plane Connection Box. NOTE: This connection box must be modified in accordance with instructions in the PB4Y-2 modification manual.

(15) Antenna Assembly. NOTE: See "Maintenance Chapter" of system manual regarding brush holder modification.

(16) Nose Junction Box. NOTE: With the nose junction box modified as per OP 688 (First Rev.) Appendix—Section I-B and II-B care should be taken to use only the new modified male break away connector with the proper latching mechanism.

PART NO.	FROM	TO	CHANGE NO.	SERIAL NO.	RECOMMENDATIONS
(18) Range switch:					
R1804	82K	2200	844C	1502	Information only. Change made to give adjustable bias. See "Maintenance Chapter" of system manual for details of wiring and adjustment.
R1806	120K	82K	844C	1502	
R1811		add	844C	1502	

NOTE: Units below serial number 451 are modified for the Range Switch (Part No. D-153314) but do not have the switch itself. It must be installed in these units when intended for use as SWOD (Radar) Mk 2 Mod 1. Range switches removed in converting to Mod 2 as in OP 688 (First Rev.), Appendix—Section II on units above serial number 2000 may be salvaged for use with units below serial number 451 if special care is taken in the mounting.

GENERAL: Units packed as List 1 or List 2 incorporate brackets intended to hold TNT charges for SWOD (Demolition System) Mk 122. These brackets must be completely removed.

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Appendix B

MODIFICATION KITS

INSTRUCTIONS FOR INCORPORATION OF "AUXILIARY TAIL ELEVATOR" ON SWOD (AIR STABILIZER) MK 13 MOD 0

Table of Contents

I. General Description of Modification

II. Pre-modification Inspection and Overhaul Requirements on All or Specific SWOD (Air Stabilizers) Mk 13 Mod 0

III. Procedure of Modification

IV. Illustrations

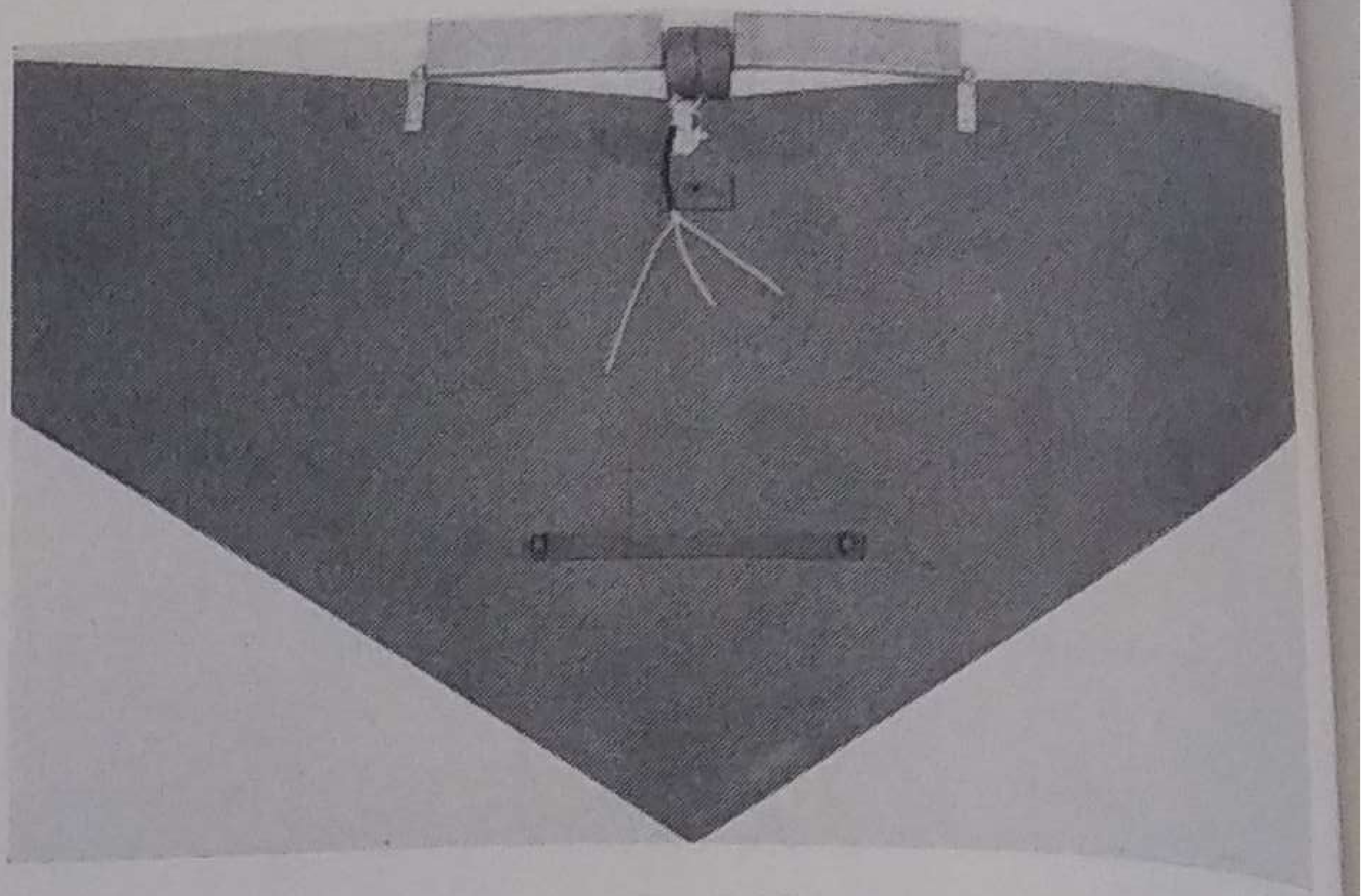

Figure 124—Auxiliary Tail Elevator Installed on Tail of SWOD (Air Stabilizer) Mk 13 Mod 0.

I. General Description of Modification

A. Purpose of Modification. The elevators are installed on the SWOD Mk 9 Mod 0 for the purpose of damping pitch oscillations. In the case of the SWOD (Air Stabilizer) Mk 13 Mod 0 (Airframe of SWOD Mk 9 Mod 0), this hunt occurs at a frequency around six cycles per minute. At this slow rate, deviation from course can be considerable. The foregoing can be counteracted by the installation of a small elevator on the trailing edge of the horizontal stabilizer and operating in the opposite angular motion of the control elevons. The action of the elevators is such that the elevators are down when the elevons are moving up and up when the elevons are moving down.

B. General Description of "Auxiliary Tail Elevator Modification Kit" for SWOD (Air Stabilizer) Mk 13 Mod 0. The "Auxiliary Tail Elevator Modification Kit" as designed for the SWOD (Air Stabilizer) Mk 13 Mod 0 consists of a relay assembly, rotary solenoid with elevator attached and the necessary mounting parts and cables. See Figure 124.

The relay assembly which is to be installed in the SWOD (Servo) Mk 4 (see Figure 125) serves as a means of obtaining signal information from the servo for operation of the elevator rotary solenoid. This is accomplished by shunting the high resistance coil of one relay across the glide servo solenoid limit switch assembly and the other across the dive servo solenoid limit switch assembly, the contacts of the relays forming the link with the elevator rotary solenoid circuit. The elevator rotary solenoid operates from the 14-volt servo battery and will not operate unless the servo is armed.

The rotary solenoid is composed of two opposed rotary solenoids operating over an overlapping arc of 25°. Although these solenoids are not of the general plunger type the principle is the same except that the armature is forced to approach the stator in a rotary motion due to the armature being supported on inclined spiral cut ball bearing races and ball bearings. It can readily be noted that only one solenoid can be and is energized during normal operation, and that a considerable torque can be exerted at the start of the stroke due to the small magnetic gap. A large arc operation is thus possible.

The torque of each solenoid in the rotary solenoid assembly is adequate throughout its arc of operation. A protective fuse is employed in the common lead of the two solenoids.

Self-aligning bearings and a flexible torque bracket are employed in the mounting of the elevator and solenoid assembly thereby minimizing friction from mounting misalignment.

C. Description of Operation of Tail Elevator Modification. When the pitch gyro

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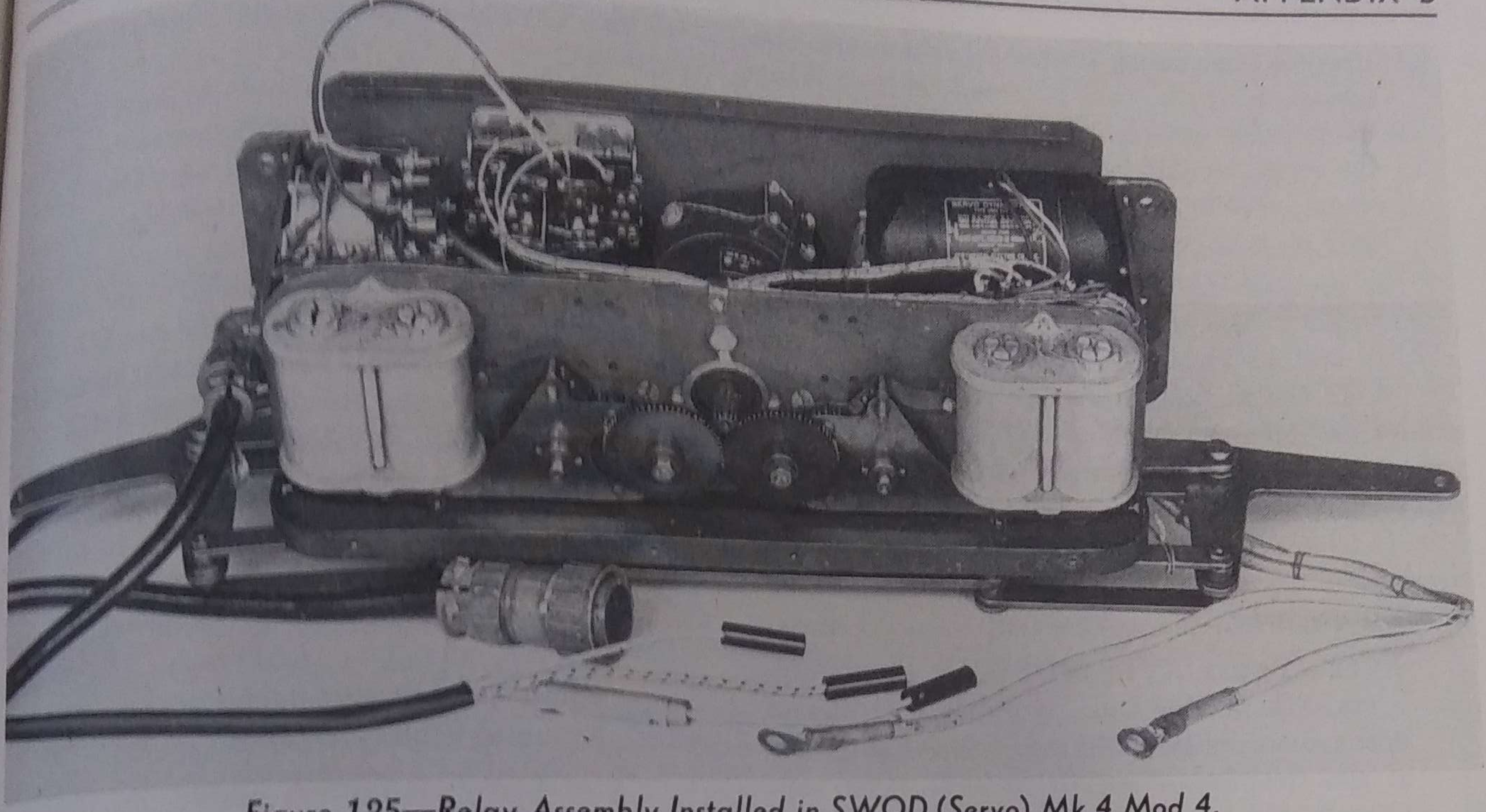

Figure 125—Relay Assembly Installed in SWOD (Servo) Mk 4 Mod 4.

operates either the dive or glide solenoid of the SWOD (Servo) Mk 4 the respective relay of the auxiliary tail elevator relay assembly closes. Closing of the relay also closes the low voltage circuit of the respective elevator rotary solenoid causing elevator fin to be thrown to whatever maximum position that solenoid operates. As aforestated, the direction of throw is always opposite to the motion of the elevon (i. e. if gyro energizes servo glide coil, the elevator fin will throw to dive position).

By use of the relay assembly all high voltages remain inside the servo, all external wiring being low potential. Circuit connections are such that electrolysis is practically impossible, also failure of tail elevator assembly will not affect normal operation of the servo mechanism.

To gain maximum results with the auxiliary tail elevator, the rate of turn of the pitch gyro on the SWOD (Gyro Panel) Mk 16 Mod 1 is increased to approximately 6° per second.

II. Pre-modification Inspection and Overhaul Requirements on All or Specific SWOD (Air Stabilizers) Mk 13 Mod 0

Careful consideration of the following information before proceeding with the modification is necessary to select air stabilizers suitable for modification and make necessary modifications. **Note:** Not all SWOD (Air Stabilizer) Mk 13 Mod 0 are equipped with SWOD (Servo) Mk 4. Air stabilizers with the SWOD (Servo) Mk 4 should be used for this modification. All SWOD (Air Stabilizer) Mk 13 Mod 0 master crates without SWOD (Servo) Mk 4 are plainly marked.

A. Preparation for Modification. **Note:** Determination of right side or left side is made by standing behind air stabilizer and looking toward its nose.

1. Uncrate SWOD (Air Stabilizer) Mk 13 Mod 0 from master crate. Do not assemble.
2. Remove all upper and lower cowlings.
3. Mount fuselage section on suitable work fixture.
4. Tighten all screws, nuts and bolts on fuselage section. Do not overtighten.

> Note: Special note should be taken to the 24 bolts which secure the metal center section to the longerons, the 10 bolts securing the bulkhead mounting brackets, and the 6 bolts securing the brackets which hold the horizontal stabilizer.

The heads of the 12 screws which secure the

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upper longerons to the metal frame are concealed beneath the plywood skin. When these bolts are tightened the thread end of the screw should be held with a hand vise if screw turns while nut is being tightened.

5. Remove cable clamp mounted on the front of the inverter shelf which formerly held prima cord cable. The demolition wiring harness included with air stabilizer may be salvaged.

6. If the air stabilizer has two arming wire guides on the top left front longeron remove one guide. Also remove arming wire guide on top right front longeron.

7. Check if elevon horns on wing sections need to be replaced. Replace with special elevon horns if necessary.

> Note: A quantity of 437 SWOD (Air Stabilizers) Mk 13 Mod 0 are equipped with elevon horns incorrectly mounted. Serial numbers of the specific air stablizers have been supplied Supply Depots and are listed in the table at the end of this section.
>
> To correct this the manufacturer has supplied special replacement elevon horns by which dimensional errors are corrected. Removing the existing elevon horns and replacing with the special horns is the only installation information required. Special replacement elevon horns are not supplied with the air stabilizer and must be obtained from SWOD Supply Depot.

8. Tighten all nuts, screws and bolts on wing sections. Do not overtighten.

9. Close hole on left side of fuselage with supplied patch plate A6914–1024–1.

10. Cut out inverter shelf for additional clearance as indicated on Figure 136 using utility or cabinet saw. Finish with one coat of wood sealer.

11. Modify bomb braces as follows: (refer to Figure 136).

> Note: See special instruction under item (h) below for fuselages bearing serial numbers less than 551.

(a) Turn fuselage upside down.

(b) Remove bomb brace angles from metal center section. Disassemble bars from angle sections.

(c) Drill a $\frac{9}{32}$-inch hole in each angle section in line with and midway between the holes by which the angles were mounted to the fuselage.

(d) Remount angles to fuselage center section in such manner that the angles are 1 inch forward from former position. This is accomplished by bolting the second hole in the angle with the first hole on the center section and the rear hole of the angle with the third hole from the front on the center section. Before mounting, zinc chromate drilled holes for rust protection.

> Note: In cases where the nuts of the hinge mounting bolts interfere with mounting, grind off angle corner to provide proper clearance. Zinc chromate all surfaces where plating has been abraised on angles or metal center sections.

(e) Using mounted angles as templates drill (use $\frac{9}{32}$-inch drill) forward and center holes of the angles through fuselage metal center section. Zinc chromate drilled holes. Install screws and bolts in holes drilled.

(f) Check if turnbuckles on bomb suspension straps are on *left* side of fuselage. (Don't forget fuselage is upside down, thereby reversing sides.) If not, unmount and remount so turnbuckles are on left side. Also check if clevis pin and bolt holding front bomb strap is inserted from bomb brace side.

(g) Mount corrugated bar on right side angle. Correct positioning of corrugated bar will be accomplished when bomb is actually installed.

(h) Special instructions for bomb braces on fuselages bearing serial numbers less than 551. Obtain special bomb brace angles, bars, and hardware from SWOD Supply depot.

(1) Observe and accomplish foregoing section (f) if necessary.

(2) Remove bomb brace angles and bars completely. *No holes are to be drilled.*

(3) Install bomb brace angle without clinch nuts or corrugations on left side of fuselage, using same hardware which mounted removed bomb braces.

(4) Mount bomb brace angle with clinch

s and corrugations on right side. Also mount rugated bar to right angle.

(i) Mount 3064–F–5 clamp with hardware vided as fuse holder. Locate as shown in gure 129. Exact location not important.

(j) Turn fuselage over to normal position.

12. Remove inertia switch arming coupling m the right side of the lower front cowling. place the mounting screws in mounting holes h nuts on inside. Fill large hole with supplied ch plate #A6914–1024–1.

13. Paint outside surfaces of patch and/or spection plates and any other scratched surfaces th sea grey paint of matching color.

II. Procedure of Modification

To obtain maximum efficiency in installation of e auxiliary tail elevator modification kit the procedure of installation is divided into independent operations.

A. INSTALLATION OF THE TAIL ELEVATOR ASSEMBLY (REFER TO FIGURE 126). A properly installed tail elevator assembly should meet the following requirements when the elevator shaft is:

(a) Equidistant from top and bottom of the horizontal stabilizer.

(b) Symmetrical about the centerline of the stabilizer.

(c) Just far enough abaft the trailing edge of the stabilizer for proper rotation of the elevator.

To accomplish this it is recommended that a template and elevator angle jig be made in accordance with Figures 127 and 128. This procedure assumes that such a template and jig will be made.

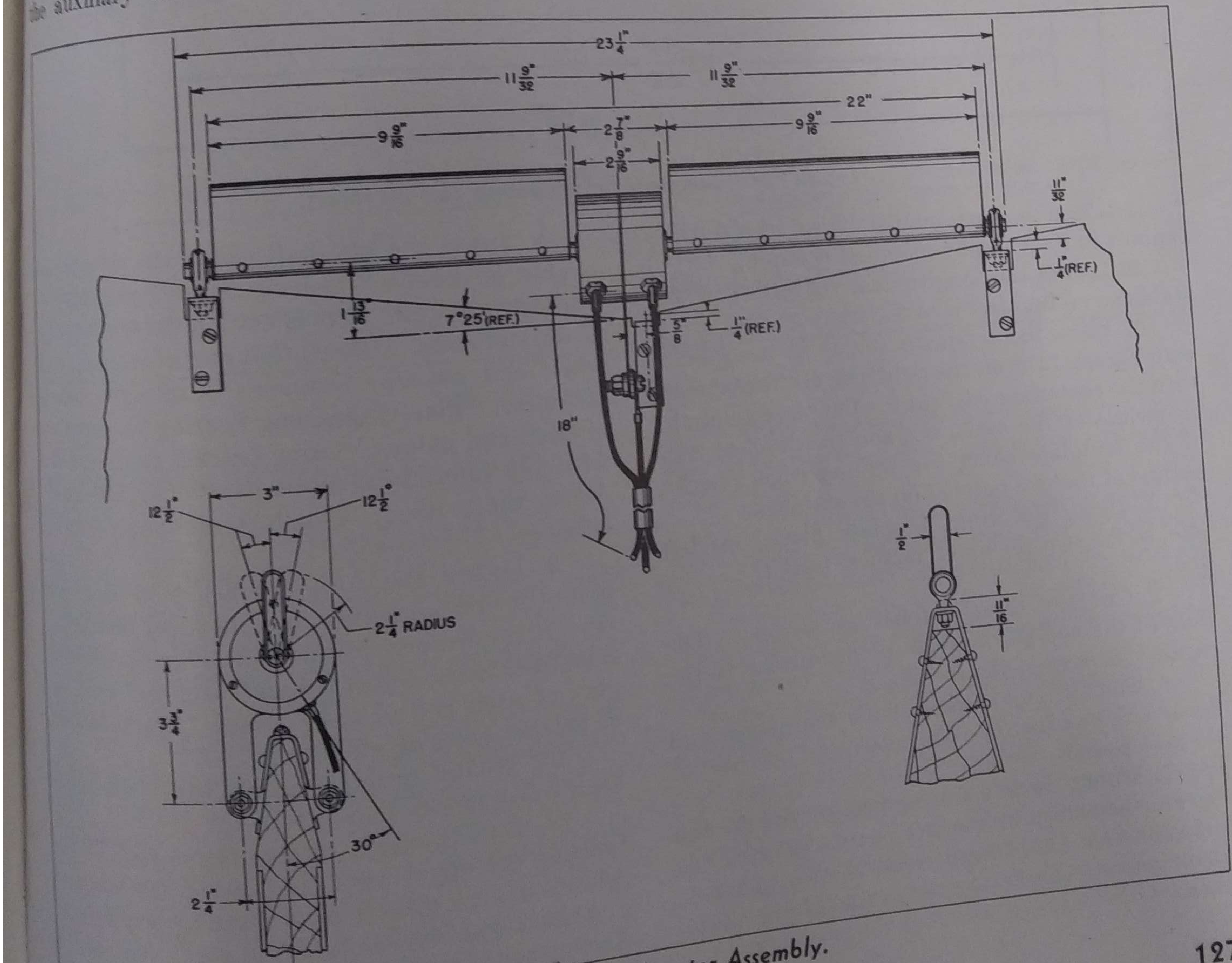

Figure 126—Elevator Assembly.

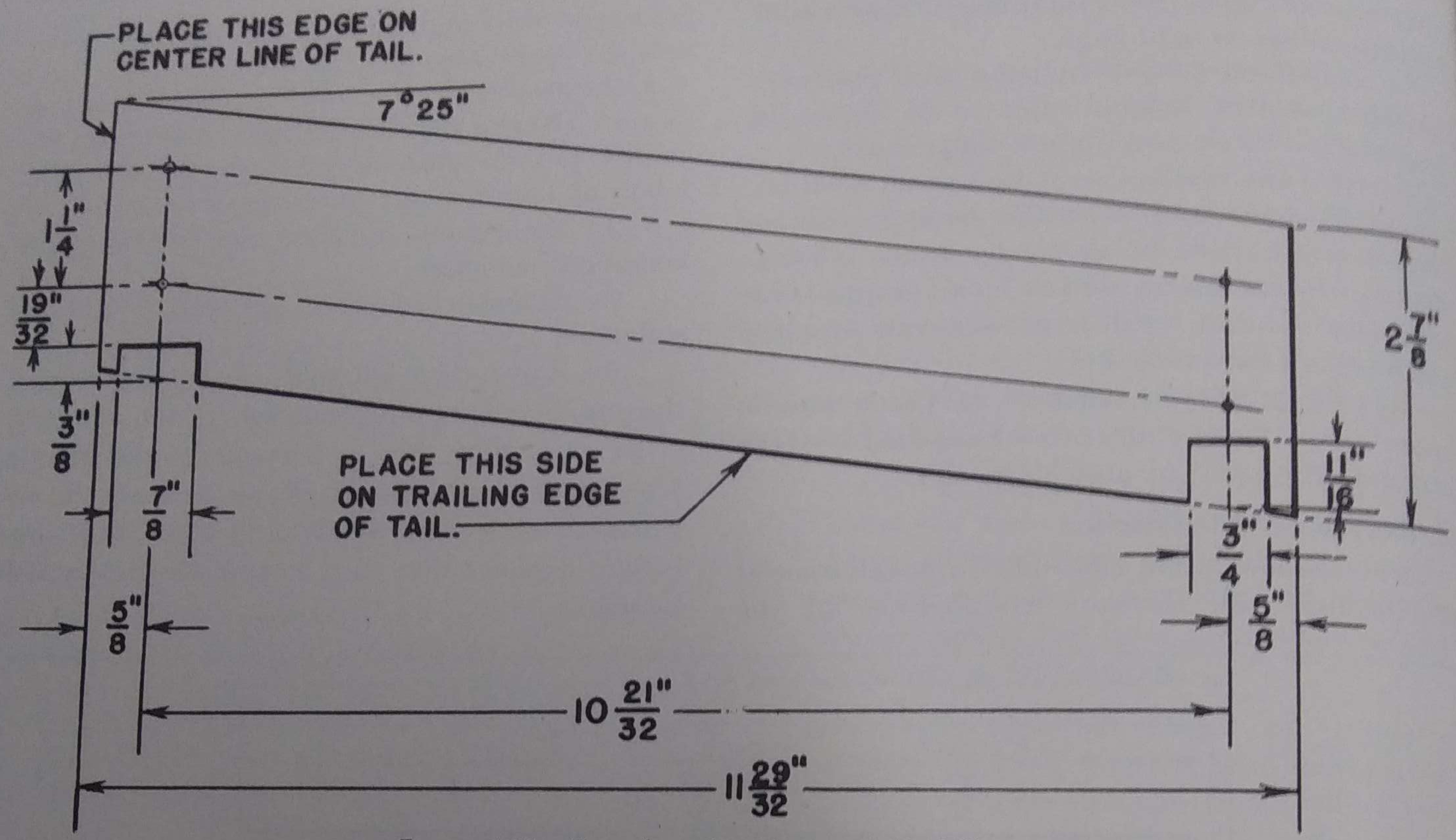
PLACE THIS EDGE ON CENTER LINE OF TAIL.
7°25"
1 1/4"
19/32"
3/8"
7/8"
PLACE THIS SIDE ON TRAILING EDGE OF TAIL.
5/8"
10 21/32"
11 29/32"
2 7/8"
11/16"
3/4"
5/8"

Figure 127—Template for Mounting Tail Elevators.

1. Place the horizontal stabilizer on a suitable support in its normally mounted position.

2. Locate the longitudinal centerline of the stabilizer and project it to the trailing edge.

3. Place the template (made in accordance with Figure 127) on the right side of the stabilizer with the centerline edge of the template along the centerline of the stabilizer, and the notched edge of the template along the trailing edge. Scribe outline of the two notches on the stabilizer.

4. Using the same template placed on left side, scribe *only* the notch farthest from the center line.

5. Cut the three notches as scribed. The sides of the notches must be perpendicular to the parallel surfaces of the stabilizer.

6. Smooth cut surfaces with sandpaper and finish with one coat of wood sealer and one coat of sea grey paint.

7. Mount the left bearing bracket for the tail elevator assembly in the left cut notch with the supplied four round head wood screws (AN550–10–6); mount parallel to centerline of the stabilizer.

8. Insert the left shaft end of the elevator assembly in mounted bearing turning assembly so that spring torque yoke is astride the trailing edge of the stabilizer. Check that end of solenoid with white and red wire terminals is to right side of stabilizer. Place remaining bearing on right end of shaft and mount bearing bracket in right notch with four round head wood screws (AN550–10–6). Allow shaft about ⅛-inch total play between bearings.

9. Locate the torque bracket in slot near center in such a manner that the lobes rest lightly against the elevator torque yoke when the elevator is parallel to the top of the stabilizer and some end play at each end of shaft exists. Mark location of bracket holes on stabilizer.

10. Mount torque bracket with four round head wood screws (AN550–10–6).

11. Bolt the forks of the torque yoke to the bracket (to finger tightness) using the supplied AN501–416–10 fillister head machine screws with a AN960–416 flat washer on each side and a AN935–416 lock washer between the flat washer and a AN345–416 hex nut. The solenoid ground

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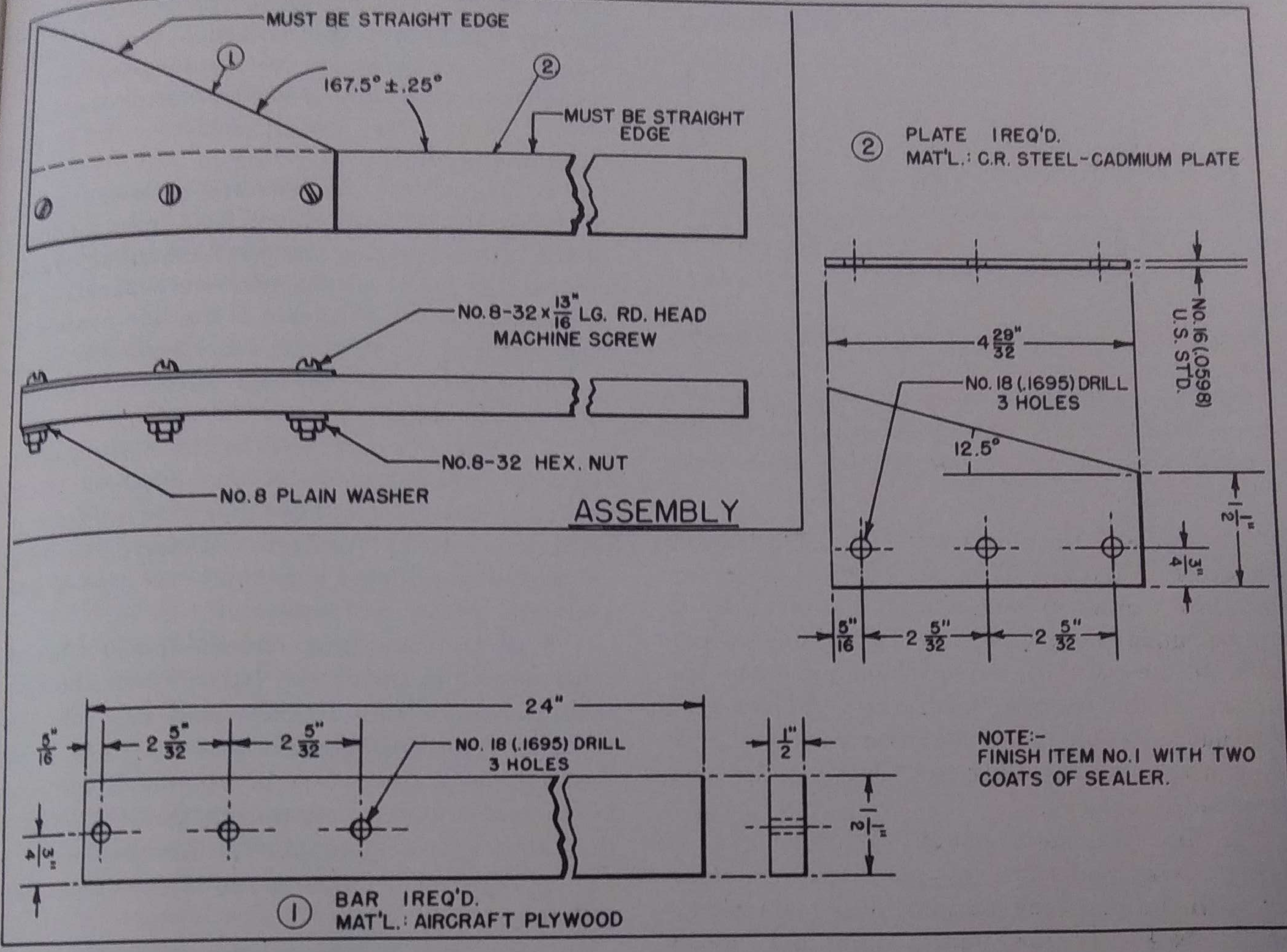

Figure 128—Elevator Angle Jig for Tail Elevators.

wire is to be mounted under the head of the upper mounting bolt.

12. Using the elevator angle jig as per Figure 128, adjust torque yoke as follows:

(a) Hold the jig with the edge of the angle plate on the flat surface of the elevator and the jig arm on the horizontal stabilizer parallel to the center line of the stabilizer.

(b) With the elevator in full dive position, rotate the solenoid assembly manually until the angle between the elevator and the angle plate disappears.

(c) Secure the bolts on the torque yoke forks and bracket with a wrench.

(d) Move elevator manually to full glide position and repeat foregoing procedure, using the under sides of the elevator and stabilizer as reference. If an angular difference is apparent, loosen the bolts and divide the difference with adjustment made for dive.

(e) Tighten bolts and recheck dive and glide angles of elevator. **Note:** The jig should be checked occasionally for warpage of the arm and misalignment of the angle plate. These checks can be made with a straight edge and a clinometer or machined template.

B. INSTALLATION OF RELAY ASSEMBLY (SEE FIGURE 125).

NOTE: To facilitate location of holes to be punched with a special hand punching tool (Whitney No. 5 Special), a template as per Figure 129 should be made. The Whitney No. 5 Special punch is supplied with a special modification tool for modification of SWOD Mk 9.

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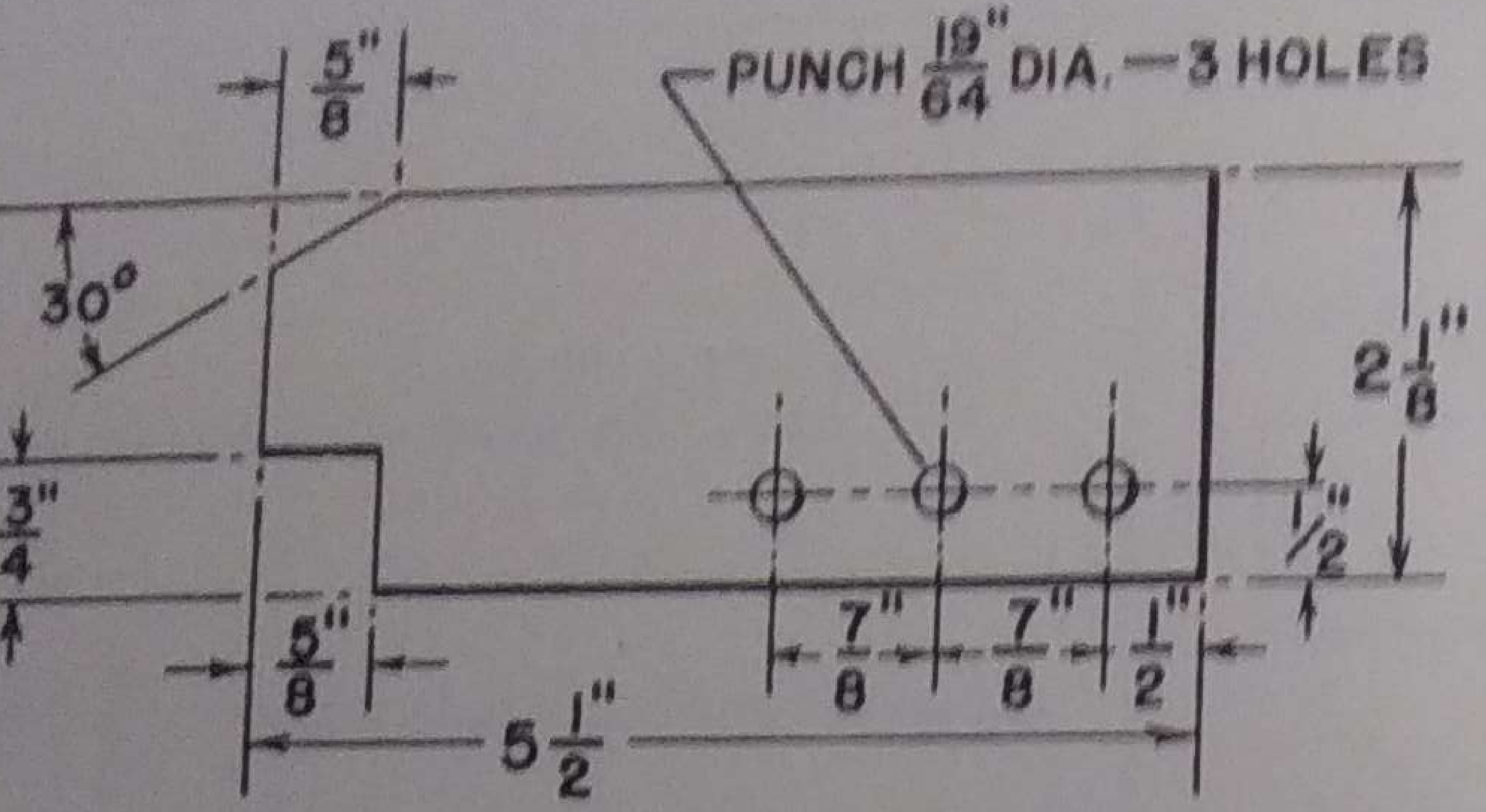

Figure 129—Template for Locating Relay Assembly

Care in handling the relay assembly should be exercised. Avoid any possibility of filings, nuts, washers, or screws getting into servo mechanism.

1. Remove the servo cover by withdrawing the screws in the top, front, and sides of the cover. The three screws in each side of the servo cover can be made more accessible by drilling ¼-inch holes in the skin of the airframe opposite the screws. If this is done, finish edges of holes with one coat of wood sealer and one coat sea gray paint after relay assembly has been installed and servo cover replaced.

2. Slip the metal punch (Whitney No. 5 Special) over lip of servo rear panel from the right side with the punching pin on the outside of the panel. **Note:** If the punch does not move freely due to insufficient space between the panel and the battery box bulkhead, the bulkhead should be beveled with a wood rasp. It may also be necessary to remove the first clinch nut on the panel. If the battery box bulkhead was beveled, the rasped surface must be refinished with one coat of wood sealer.

3. Place the relay mounting template (Figure 129) on the outside of the servo panel inserting the punching pin in one of the template holes then moving the template so that the top and right sides of the template and panel are in line. Punch the required three holes. **Note:** Precaution must be taken to be sure that the punching pin enters the template holes in a concentric manner. Previous removal of the centering tip on the punching pin will aid in alignment.

4. Enlarge the center hole with a ⅝-inch Greenlee chassis punch.

Caution: The use of of the Whitney No. 5 Special punch and the Greenlee ⅝-inch chassis punch is recommended to avoid possibility of particles from drilling or filing entering the servo.

5. Paint cut metal surfaces with zinc chromate paint.

6. Thread the tube covered cable of the relay assembly through the ⅝-inch hole from the inside of the servo, bringing the relay mounting bracket against the inside of the rear servo panel. (The bottom of the relay bracket is the side nearest the weld screws.) Secure the relay assembly to the panel by using flat washers AN960-5 and lock nuts AN365-1032.

7. Drill a ⅝-inch hole in the bottom of the rearmost compartment of the fuselage, ⅞-inch abaft the battery box fillet and 2 inches from the right side of the fuselage. Remove the rough edges with sandpaper and apply one coat of wood sealer to the worked surface.

8. Route the tube covered cable from the relay assembly under the battery box above the stabilizer mounting bracket and into the after compartment through the hole described in section 7. Note that cable is not pinched by long horizontal stabilizer mounting pin. Also check if 10 ampere fuse is installed in fuse holder.

9. Secure the cable in the after compartment as follows:

(a) Drill a cable clamp mounting hole in the right side of the fuselage 10 inches before the rear bulkhead and 3½ inches above the bottom of the longeron, using a drill size No. 9.

(b) Clasp the fuse holder for the ground wire and the two remaining wires together with the supplied cable clamp No. 3064-F-5.

(c) Mount the cable clamp, using a round head machine screw AN520-10-10, a flat washer, AN970-3, a split-type lockwasher AN935-10, and a hexagonal nut AN345-10, inserting the screw from the outside of the compartment.

10. Drill a ⅝-inch hole in the rear bulkhead 2 inches from the right side of the fuselage and 3½ inches from the bottom of the longeron. Finish hole with wood sealer and sea grey paint. This hole is to be used to bring the solenoid wires into the rear compartment for electrical connections after the horizontal stabilizer has been attached to the fuselage.

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C. Electrical Connections: (Refer to Figures 130, 131, 132). **Note:** Figures 130, 131, and 132 are schematics for the three methods of wiring used by the manufacturer on the SWOD (Servo) Mk 4 Mod 4. If it is necessary to refer to these figures a quick determination as to which figure applies can be made as follows:

(1) Figure 130 applies to SWOD (Servo) Mk 4 Mod 4 constructed on contract NOrd 4813 having terminal binding posts with six terminals in line.

(2) Figure 131 applies to SWOD (Servo) Mk 4 Mod 4 bearing serial numbers 1851 to 2000, inclusive, having terminal binding posts with two rows of three terminals. The majority of these were constructed on contract NOrd 8130.

(3) Figure 132 applies to *all* SWOD (Servo) Mk 4 Mod 4 constructed on contract NOrd 8130 and having serial numbers above 2000.

1. Connect the three small stripped and tinned wires which are cabled together from the relays as follows. All three leads are to be connected to terminal strip on dynamotor side of servo. Clamp wires to lugs and solder securely.

(a) Connect the white wire with red tracer to the same terminal which the red (positive) wire from the dynamotor connects to.

(b) Connect white wire with blue tracer to the same terminal which carries blue wire coming out of the cable from the SWOD (Gyro Panel) Mk 16 Mod 1.

(c) Connect the white wire with the green tracer the same terminal which carries the orange wire coming out of the cable from the gyro panel.

(d) Route the cable from the relay assembly to the front panel, thence along panel. Unfasten cable clamp over motor and include relay cable in clamp. Refasten.

> Note: The color coding of the limit switch wires in the servo is the same as the signal wires. Therefore, a low resistance circuit test should be made. This should be done by checking continuity and resistance between terminal pin "B" of the connector which connects to the gyro panel and the white wire with green tracer of the relay assembly cable; also check between terminal pin "A" and the white wire with blue tracer. If any appreciable resistance is indicated, incorrect connections have been made, possibly due to the afore-mentioned similarity of color coding of limit switch leads.

2. Connect black wire with solder lug on relay assembly to contractor terminal which carries the positive (red color) servo motor and white dynamotor lead.

3. Connect white wire with lug from relay assembly to the contractor mounting bolt which carries the black wires from the servo motor and dynamotor.

4. Re-inspect all connections made.

5. Re-install servo cover. Paint heads of screws with glyptol if available.

6. Mount rear horizontal stabilizer.

7. Route solenoid leads through previously drilled ⅝-inch hole in rear bulkhead.

8. Connect leads from solenoid to leads from servo of similar color. If disconnect terminals pull apart too easily, crimp male tips *slightly*.

D. Increase Rate of Turn on Pitch Gyro to 6°/Second on SWOD (Gyro Panel) Mk 16 Mod 1 as Follows:

1. Remove pitch gyro from gyro panel.

2. Test gyro to determine operating condition, using the special cable with alligator clips provided with the modified gyro test unit* and the test procedure outlined in Western Electric Field Manual for SWOD Mk 9 Mod 0.

3. Remove bakelite cover from gyro by removing the four No. 6 fillister head screws in cover.

4. Mark position of slots in bias adjustment screws on armature plate with pencil.

5. Advance each of the two screws clockwise 1¼ full revolutions (450°).

6. Holding bakelite cover in place, tightly apply vacuum suction to outlet or apply slight air pressure to inlet until gyro wheel rotates at reasonable operating speed. Holding gyro stationary, leave one of the bias adjustment screws fixed and

---

*All gyro test units constructed have been modified. The modification allows finer adjustment to be made. It should be noted that the meter scales on the modified unit are different from those shown in OP1696, SWOD (Special Weapon) Mk 9 Mod 0.

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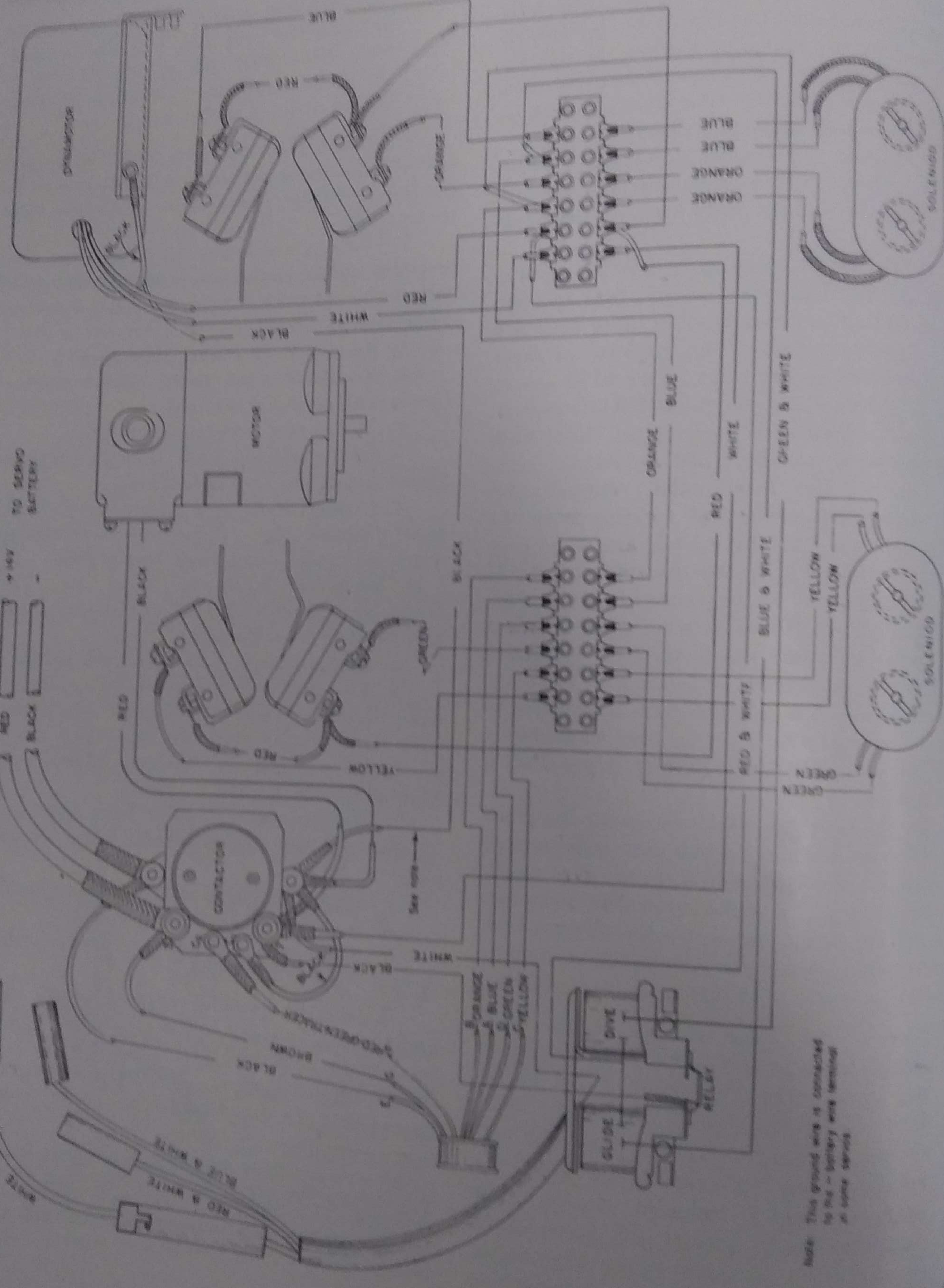

NOTE: This ground wire is connected to the – battery wire terminal in some servos.

Figure 130—Wiring of SWOD (Servo) Mk 4 Mod 4 and Elevator (Relay, NOrd 4813, for Servos Having Serial Numbers below 1851).

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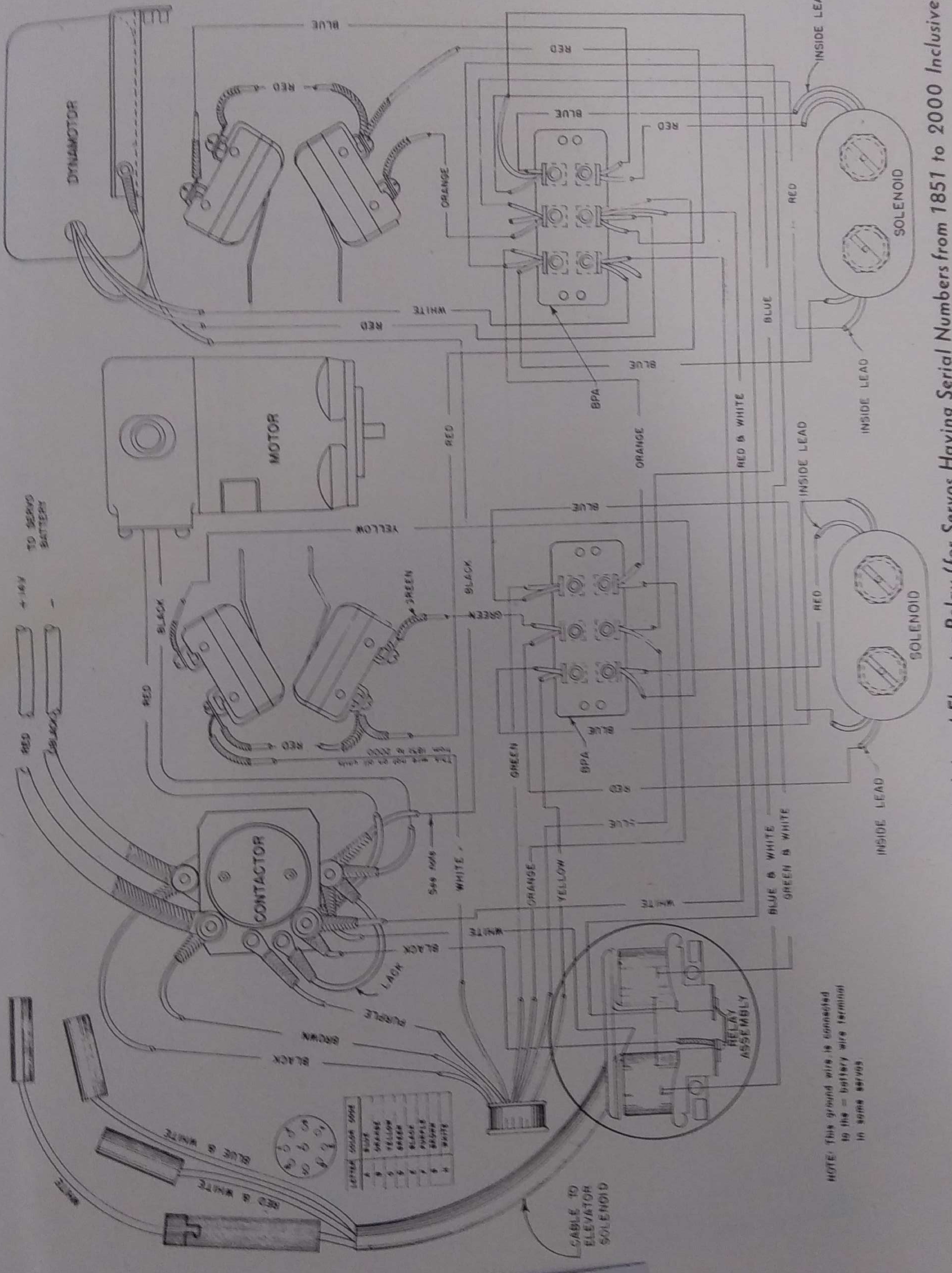

Figure 131—Wiring of SWOD (Servo) Mk 4 Mod 4 and Elevator Relay (for Servos Having Serial Numbers from 1851 to 2000 Inclusive).

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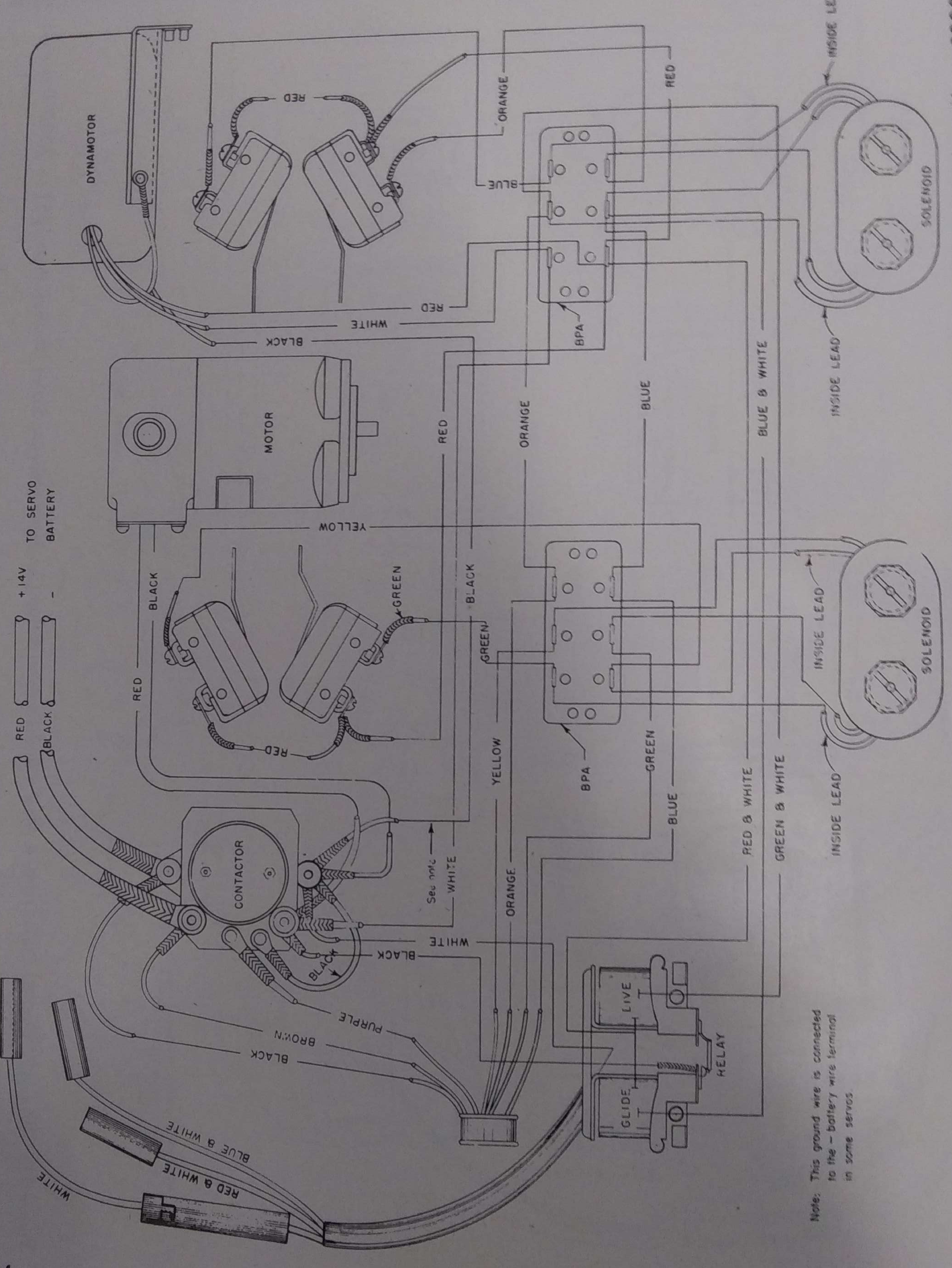

Note: This ground wire is connected to the – battery wire terminal in some servos.

Figure 132—Wiring of SWOD (Servo) Mk 4 Mod 4 and Elevator Relay (NOrd 8130, for Servos Having Serial Numbers Above 2000).

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adjust the other, if necessary, until the conditions of the following test are satisfied.

(a) Apply 4 milliamperes current to one coil and 3.5 milliamperes to the other. Increase the 3.5 milliamperes until the meter on gyro test unit indicates contact reversal. The current reading at reversal should *not* exceed 4.8 milliamperes. Reduce current in coil in which it was being increased to 4 milliamperes. Reduce current in other coil to 3.5 milliamperes. Increase current in this coil until contact reversal is indicated. Current reading at reversal should *not* exceed 4.8 milliamperes. *The difference between the values at which the two reversals occur should not exceed 0.1 milliampere.* If requirements cannot be met obtain another gyro. Gyros not meeting requirements should be forwarded to agency with equipment for major readjustment. **Note:** If gyros do not bear yellow stripes the 4.8 milliampere figure should be *less* than 4.4 milliamperes.

7. Replace gyro cover making sure that rubber sealing ring is in place.

8. Repeat test outlined under **6**, pp. 131, 135.

9. Label or mark gyro to indicate that adjustment to 6°/second has been made

10. Remount and reconnect on gyro panel.

E. Check Out. No modification to the general check-out procedure is necessary except that it will be noted that the tail elevator operates instantaneously in the opposite direction in which the elevons are moving.

Static balance, spinner angle, and decalage adjustments are made in normal manner. **Note:** Method of making static balance, spinner angle and decalage adjustments will be found in this publication under "Incorporation of Fuselage Modification Kit in SWOD (Air Stabilizer) Mk 13 Mod 0". Appendix B, Section V-E-2 & 3, F, G & H on pages 148–9.

Spinner angle and decalage settings of SWOD Mk 9 Mod 0 *may not be the same as those set forth in aforementioned reference.* Obtain proper settings from cognizant source.

IV. Illustrations

Figure 124. Auxiliary Tail Elevator Installed On SWOD (Air Stabilizer) Mk 13 Mod 0.

Figure 125. Relay Assembly Installed In SWOD (Servo) Mk 4.

Figure 136. Cutout For Inverter Shelf and Modification For Bomb Braces.

Figure 126. Elevator Assembly.

Figure 127. Template For Mounting Tail Elevators.

Figure 128. Elevator Angle Jig For Tail Elevators.

Figure 129. Template For Locating Relay Assembly.

Figure 130. Wiring For SWOD (Servo) Mk 4 and Elevator Relay for Servos Having Serial Numbers Below 1851.

Figure 131. Wiring For SWOD (Servo) Mk 4 and Elevator Relay for Servos Having Serial Numbers From 1851 to 2000 Inclusive.

Figure 132. Wiring For SWOD (Servo) Mk 4 and Elevator Relay For Servos Having Serial Numbers Above 2000.

INSTRUCTIONS FOR INCORPORATION OF "FUSELAGE MODIFICATION KIT" AND ASSEMBLY OF SWOD (AIR STABILIZER) MARK 13 MOD 1 WITH ASSOCIATE EQUIPMENT

Table of Contents

I. Purpose of Modification.
II. General Description of Modification.
III. General Information on specific SWOD (Air Stabilizer) Mk 13 Mod 0.
IV. Procedure of Modification.
V. Assembly of SWOD (Air Stabilizer) Mk 13 Mod 1 with Associate Equipment.
VI. Illustrations.

I. Purpose of Modification

The purpose of the "Fuselage Modification Kit" is to convert the SWOD (Air Stabilizer) Mk 13 Mod 0 to SWOD (Air Stabilizer) Mk 13 Mod 1 which is primarily intended to adapt the SWOD (Control System) Mk 18. Other improvements of minor nature are included in the modification.

II. General Description of Modification

The SWOD (Air Stabilizer) Mk 13 Mod 0 as originally constructed incorporates the SWOD (Servo) Mk 4 (Flight Control Servo PU-146/DPN-2). To adapt the SWOD (Control System)

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Mk 18 to the aforementioned air stabilizer alterations must be made for mounting of the control system which is considerably larger and heavier. Relocation of horizontal stabilizer and installation of larger vertical tail surfaces comprise the changes necessary to aerodynamic surfaces for maximum performance with the SWOD (Control System) Mk 18.

Addition of another Venturi tube meets the vacuum requirements of the gyro of the control system.

The additional weight of the control system and the modification of aerodynamic surfaces shifts the center of gravity of the missile considerably, necessitating a shifting of the bomb forward and installation of balance weight on the nose bulkhead. Shifting of the bomb is permitted by modification of the existing bomb braces. The aforementioned weight is incorporated on the wood bulkhead furnished with the fuselage modification kit.

Improvement toward servicing fuses is also made by means of convenient hand holes with covers.

Removal of components of SWOD (Demolition Unit) Mk 122 is accomplished in the procedure of modification.

The fuselage modification kit has been designed to minimize difficult and long operations. Strict observance of the procedure will permit maximum speed of modification and avoidance of difficulties.

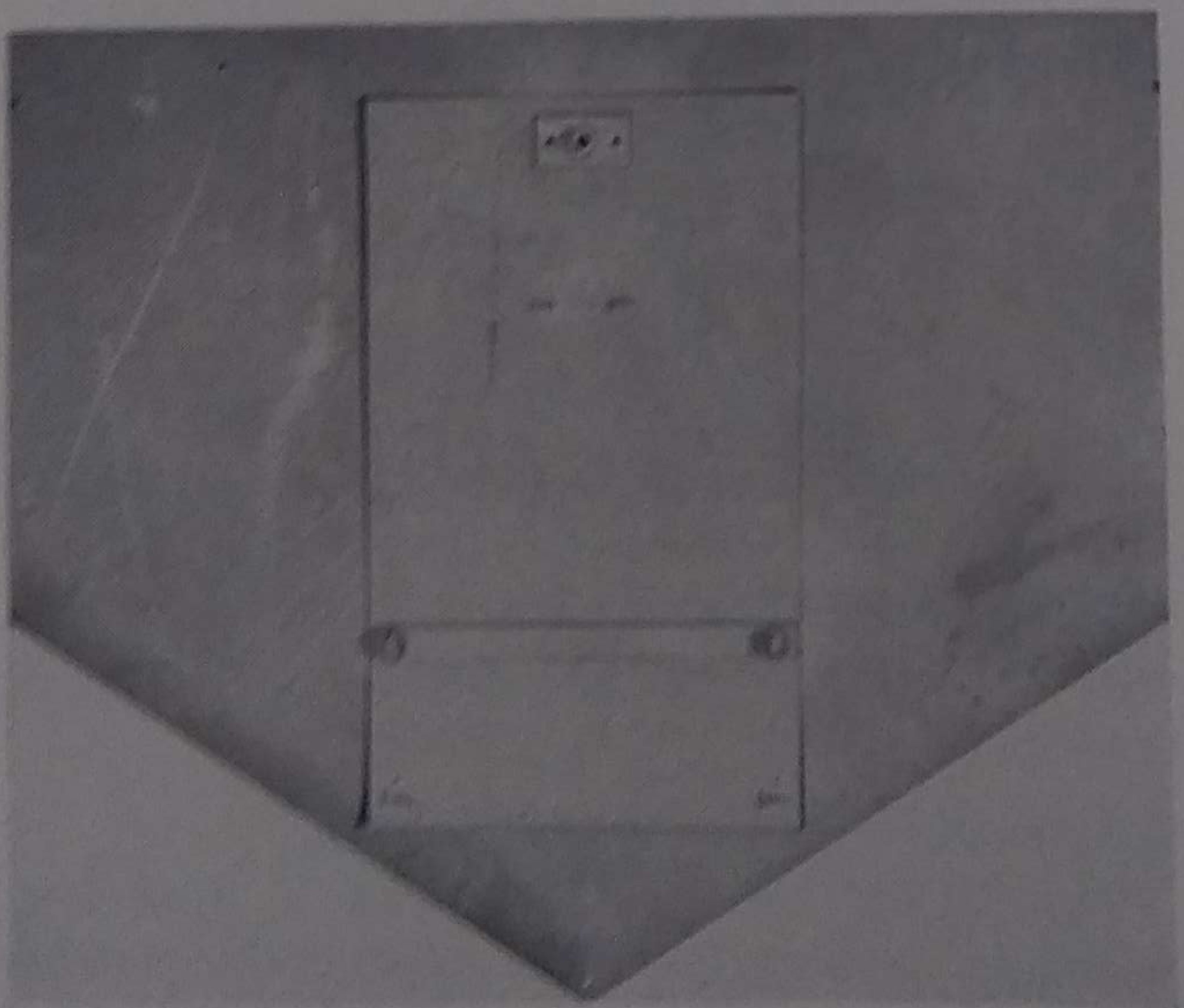

Figure 133—Template Location on Horizontal Stabilizer.

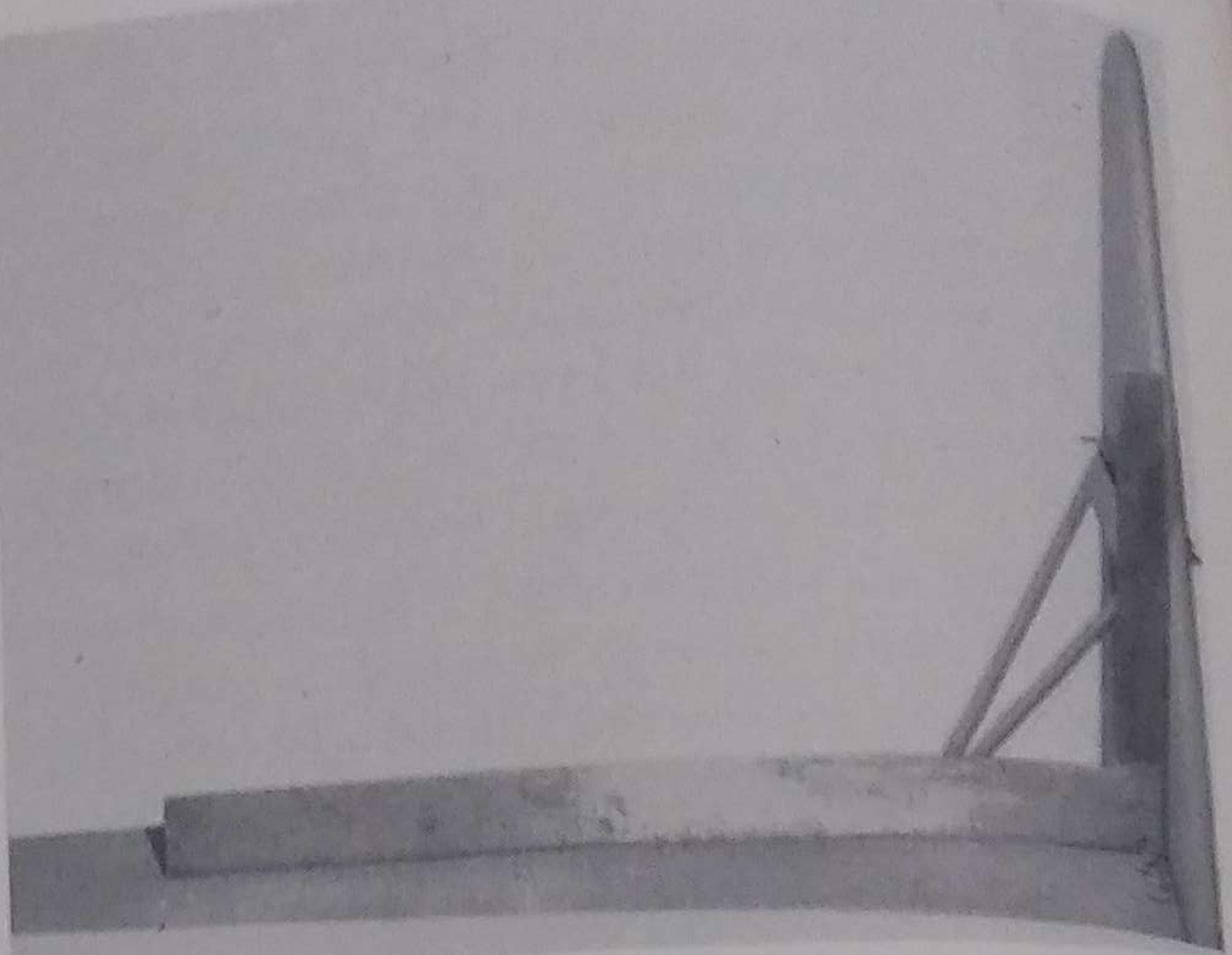

Figure 134—Spanwise Alignment of Vertical Fin Surface with Reference to Horizontal Stabilizer Surface.

III. General Information on Specific SWOD (Air Stabilizers) Mark 13 Mod 0

Careful consideration of the following information before proceeding with the modification will save much time:

1. Not all SWOD (Air Stabilizers) Mk 13 Mod 0 were equipped with SWOD (Servo) Mk 4 (Flight Control Servo PU–146/DPN–2). Air Stabilizers without the SWOD (Servo) Mk 4 (Flight Control Servo PU–146/DPN–2), should be used for this modification, thereby allowing those with SWOD (Servo) Mk 4 (Flight Control Servo PU–146/DPN–2) to remain SWOD (Air Stabilizer) Mk 13 Mod 0.

All SWOD (Air Stabilizer) Mk 13 Mod 0 master crates without SWOD (Servo) Mk 4 (Flight Control Servo PU–146/DPN–2) are plainly marked.

2. Elevon Horns: A quantity of 437 SWOD (Air Stabilizers) Mk 13 Mod 0 are equipped with elevon horns incorrectly mounted. Serial numbers of the specific air stabilizers are shown at the end of this section, page 150.

To correct this the manufacturer has supplied special replacement elevon horns by which dimensional errors are corrected. Removing the existing elevon horns and replacing with the special horns is the only installation information required.

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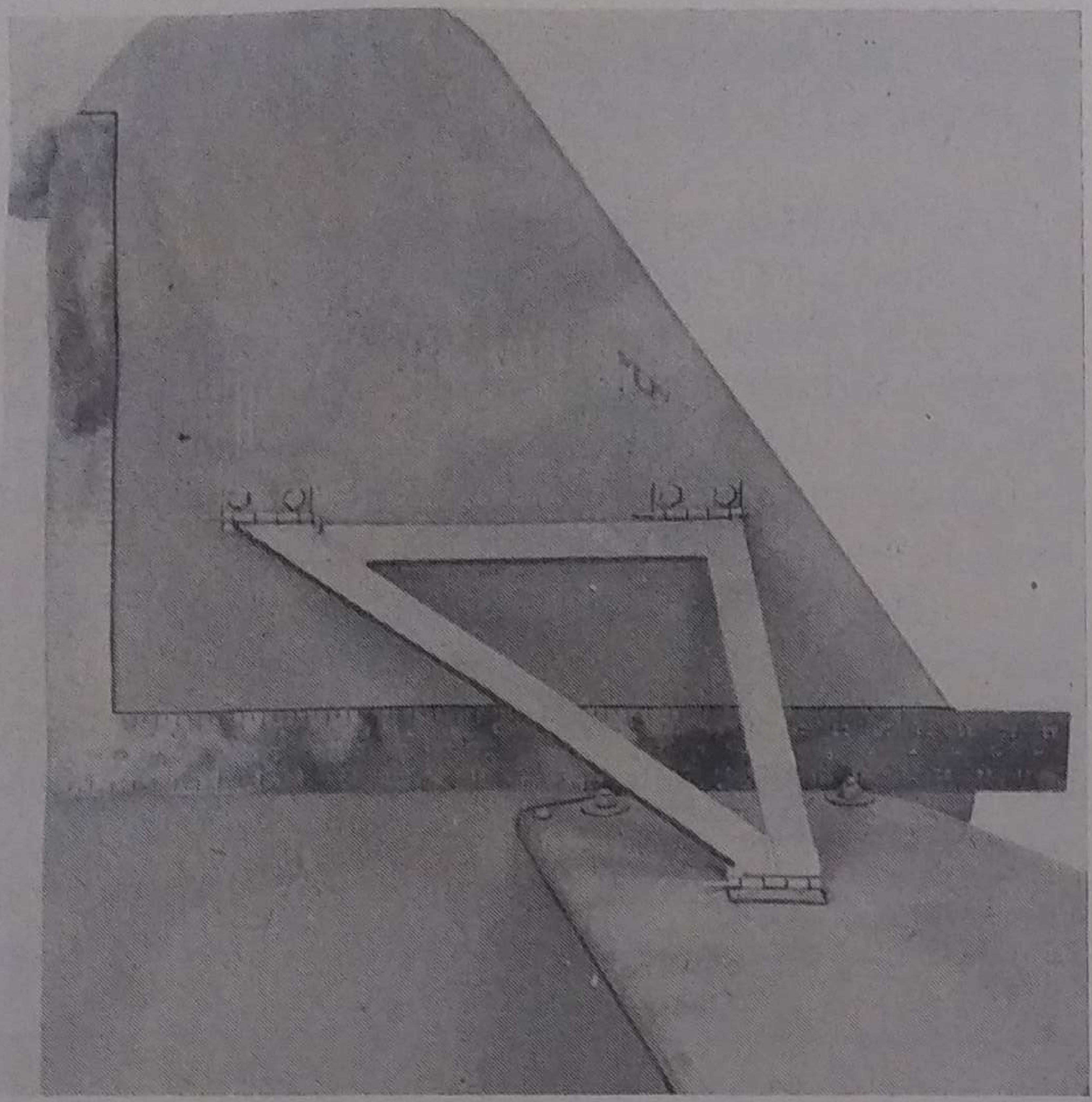

Figure 135—Method of Alignment of Trailing Edge of Fin with Reference to Horizontal Stabilizer Surface.

The special replacement elevon horns are not supplied with the fuselage kit and must be obtained from SWOD supply depot.

3. SWOD (Air Stabilizers) Mk 13 Mod 0 bearing serial numbers less than #551 incorporate a bomb brace which will not permit movement of bomb forward as required for the SWOD (Control System) Mk 18.

Replacement bomb braces must be obtained from SWOD supply depot if needed. Instructions for installation are given (page 140) in IV–B–7 under "Bomb Brace Modification".

IV. Procedure of Modification

A. Preparation for Modification:

1. Uncrate SWOD (Air Stabilizer) Mk 13 Mod 0 from master crate. Do not assemble.

Note: Determination of right side or left side is madè by standing behind air stabilizer and looking toward its nose.

2. Remove all upper and lower cowlings.

3. Mount fuselage section on suitable work fixture.

4. Tighten all screws, nuts and bolts on fuselage section. Do not over-tighten.

Note: Special note should be taken to the 24 bolts which secure the metal center section to the longerons, the 10 bolts securing the bulkhead mounting brackets, and the 6 bolts securing the brackets which hold the horizontal stabilizer.

The heads of the 12 screws which secure the upper longerons to the metal frame are concealed beneath the plywood skin. When these bolts are tightened the thread end of the screw should be held with a hand vice if screw turns while nut is being tightened.

5. Remove cable clamp mounted on the front of the inverter shelf which formerly held prima cord cable. The demolition wiring harness included with air stabilizer may be salvaged.

6. Remove filler panel on right side of servo compartment. (Filler shortened the servo arm slot.)

7. Remove SWOD (Servo) Mk 4 (Flight Control Servo PU–145/DPN–1) mounting angles.

8. If the air stabilizers have two arming wire guides on the top left front longeron remove one guide. Also remove arming wire guide on top right front longeron. This will leave one guide on each side of fuselage.

9. Remove the two cable clamps at the top of the battery box bulkhead. Retain screws for later use, also clamp on left side of compartment.

10. Check if elevon horns on wing sections need to be replaced. Replace with special elevon horns if serial number of air stabilizer appears on page at end of Appendix B, page 150.

11. Tighten all nuts, screws and bolts on wing sections. Do not overtighten.

B. Modification of Fuselage Section:

1. Close hole on left side of fuselage with supplied patch plate A6914–1024–1.

2. Cut out slot to clear added Venturi tube on left side as follows:

(a) Mount Venturi tubes on metal bulkhead with supplied $\frac{6}{32}$ x $1\frac{9}{16}$ inches flat head machine screws inserted from rear side of metal bulkhead. Use AN960–6L plain washers and AN364–632 stop nuts. (Lead balance weight is on front side. Boss of each Venturi will rest on front side of metal bulkhead with the Venturi tube facing rear.)

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(b) Screw "T" fitting (AN826-6D) into Venturi on right side and "L" fitting (AN822-6D) into Venturi on left side. Turn carefully with wrench until fitting elbows approximately line up with marking on metal bulkhead. Fittings when lined up accordingly should be tight.

(c) Connect 18-inch hose assembly between "L" and "T" fitting.

(d) Mount bulkhead assembly into fuselage and line up mounting holes in wood bulkhead with holes in brackets on fuselage. Scribe outside limits of new Venturi onto fuselage ring facing. Remove bulkhead. Mark off slot using above scribe marks and a line 11/16 inch from face of ring. Cut out slot with utility saw. Rasp and sandpaper after sawing. *Do not saw or rasp to exceed a ¾ inch depth.*

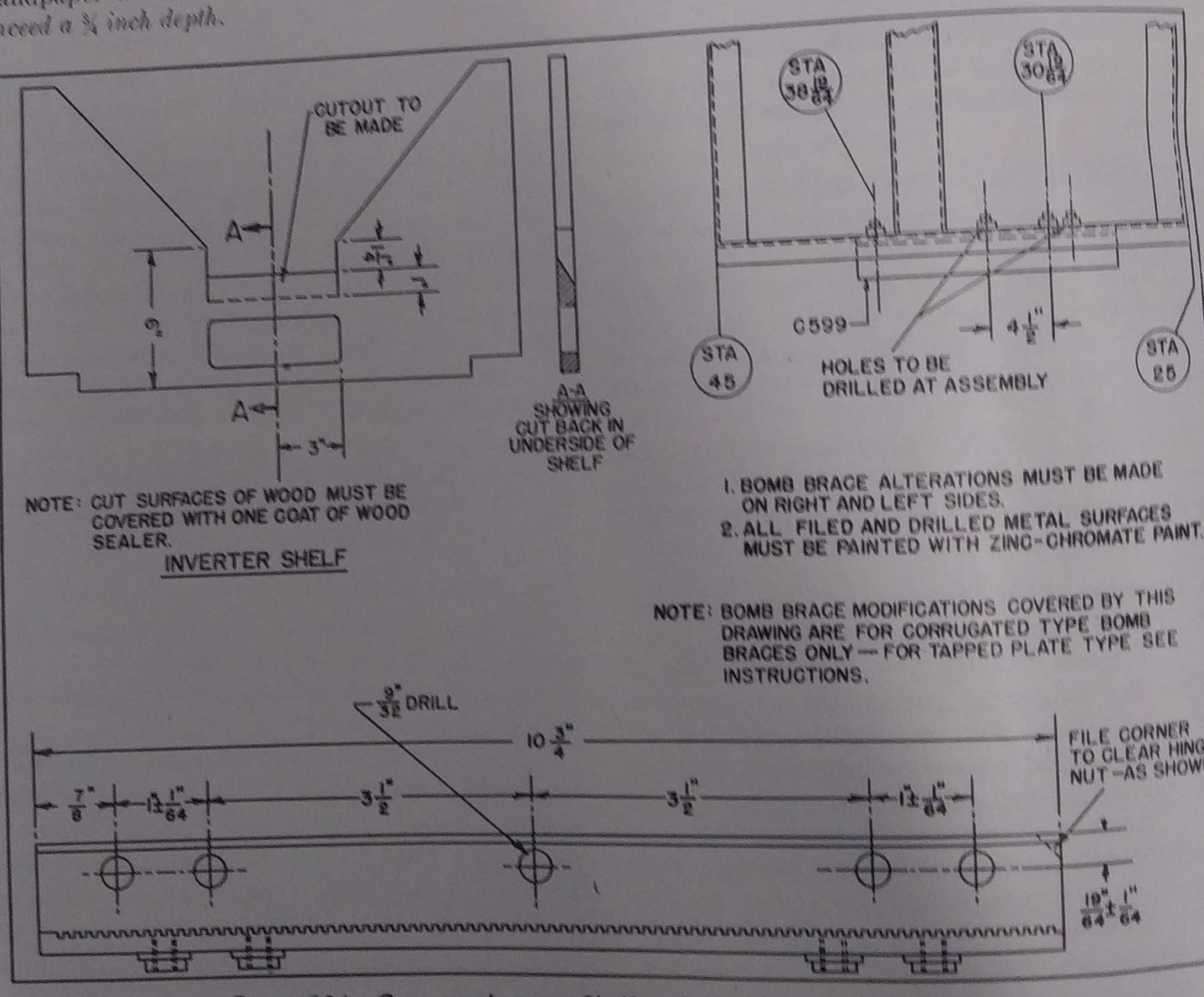
3. Cut inverter shelf for additional clearance as indicated on Figure 136 using utility or cabinet saw.

4. Modify servo compartment as follows: (Use Figure 137 as reference.)

(a) Move arming wire guide on right side of servo compartment 1 inch down and ¾ inch to the rear of the present position so the washer rests on mounting pad. After assembly cut screw off close to nut.

(b) Remove front hinge sections for upper rear cowling and remount using provided AN525-10-20 washer head screws and AN364-1032 stop nuts. In remounting install screws from opposite direction so that nut rests on hinge section.

(c) At point where upper wooden longerons are bolted to metal bracket of metal center section



NOTE: CUT SURFACES OF WOOD MUST BE COVERED WITH ONE COAT OF WOOD SEALER.

1. BOMB BRACE ALTERATIONS MUST BE MADE ON RIGHT AND LEFT SIDES.
2. ALL FILED AND DRILLED METAL SURFACES MUST BE PAINTED WITH ZINC-CHROMATE PAINT.

NOTE: BOMB BRACE MODIFICATIONS COVERED BY THIS DRAWING ARE FOR CORRUGATED TYPE BOMB BRACES ONLY — FOR TAPPED PLATE TYPE SEE INSTRUCTIONS.

Figure 136—Cutout in Inverter Shelf and Modification of Bomb Brace.

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the two rear screws holding the aforementioned items must be sawed off close to nut. Dress lightly with fine file.

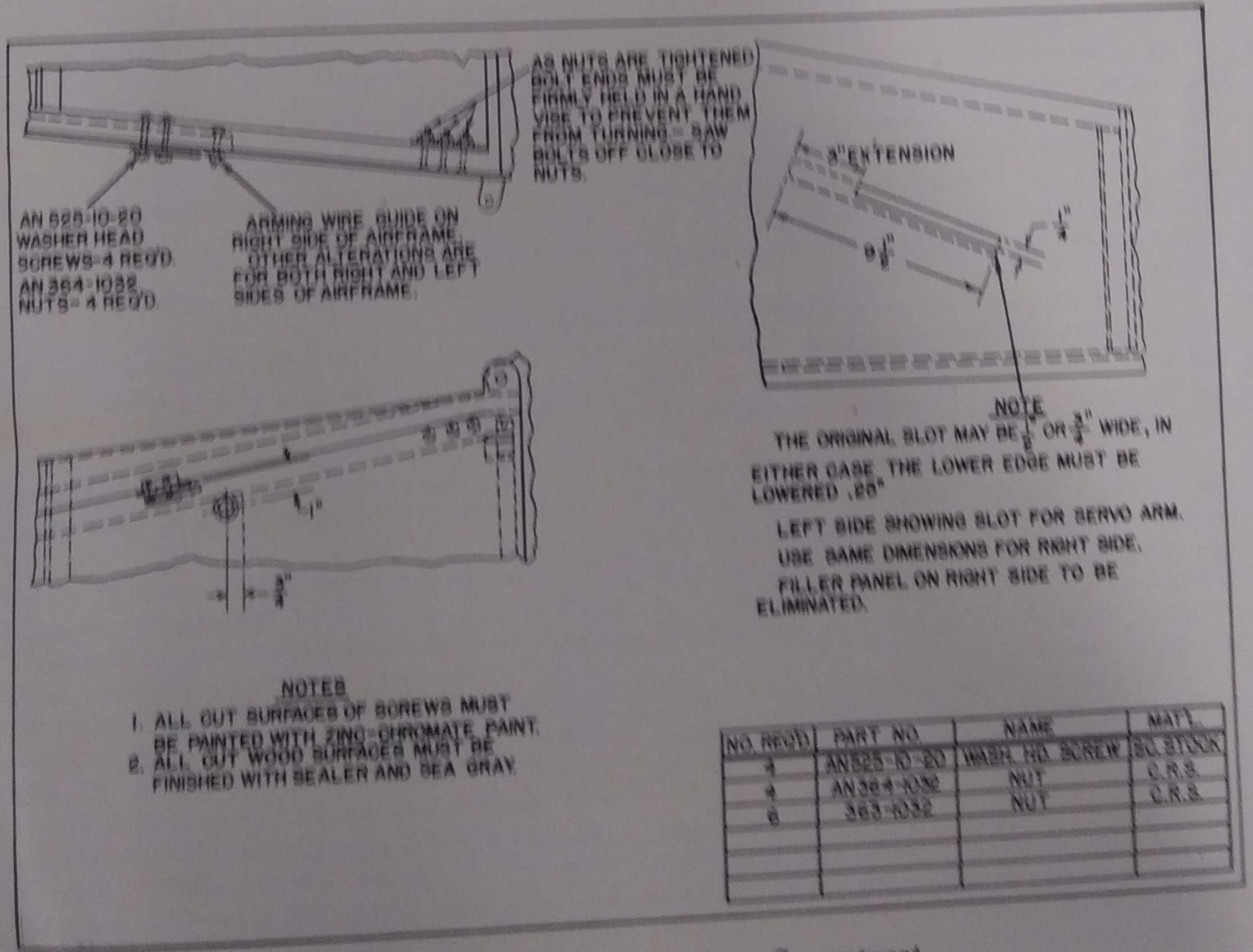
(d) Extend output arm slots on right and left sides forward so that overall length of slots are 9½ inches as measured from the rear of the existing slots. At the same time lower slots ¼ inch over the 9½ inches length. Do not lower slot on right beyond 9½ inches where filler was removed. Refer to Figure 75.

> NOTE: Some fuselages have output arm slots ½ inch in width and others are ¾ inch in width. In all cases slots must be lowered as stated above.

(e) Mount wood mounting pads supplied with fuselage modification kit as follows:

(1) Remove beads of dry glue along the glue joints formed by the side of the fuselage, the battery box bulkhead and the lower gusset plate.

(2) Fit mounting pad for left side in position in the servo compartment. Be sure the rear and base of the mounting pad is flush against battery box bulkhead and gusset. If the pad is not seated properly, clean surfaces until proper seating is attained. Drill only the forward mounting holes of the rear group of holes and the rear holes of the forward group of holes with a 9/32-inch drill. Bolt pad temporarily on outside of fuselage with ¼-inch bolts, and drill remaining holes from outside of fuselage. Extreme care should be taken that holes are drilled perpendicular to surface and that all holes drilled line up with pad used as template. Remove pad after


AS NUTS ARE TIGHTENED BOLT ENDS MUST BE FIRMLY HELD IN A HAND VISE TO PREVENT THEM FROM TURNING—SAW BOLTS OFF CLOSE TO NUTS.
AN 525-10-20 WASHER HEAD SCREWS-4 REQ'D.
AN 364-1032 NUTS-4 REQ'D.
ARMING WIRE GUIDE ON RIGHT SIDE OF AIRFRAME. OTHER ALTERATIONS ARE FOR BOTH RIGHT AND LEFT SIDES OF AIRFRAME.
3" EXTENSION
9½"
¼"
1"
¾"

NOTE

THE ORIGINAL SLOT MAY BE ½" OR ¾" WIDE, IN EITHER CASE THE LOWER EDGE MUST BE LOWERED .25"

LEFT SIDE SHOWING SLOT FOR SERVO ARM.

USE SAME DIMENSIONS FOR RIGHT SIDE.

FILLER PANEL ON RIGHT SIDE TO BE ELIMINATED.

NOTES

1. ALL CUT SURFACES OF SCREWS MUST BE PAINTED WITH ZINC-CHROMATE PAINT.
2. ALL CUT WOOD SURFACES MUST BE FINISHED WITH SEALER AND SEA GRAY.

NO. REQ'D.	PART NO.	NAME	MAT'L.
4	AN525-10-20	WASH. HD. SCREW	SU. STOCK
4	AN364-1032	NUT	C.R.S.
6	363-1032	NUT	C.R.S.

Figure 137—Modification of Servo Compartment.

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drilling. (Gluing of pads permanently will be covered under Section D.)

(3) Hold servo mounting pads in location on inside of fuselage and mark outline of pad. Clean and sandpaper surface covered by pad.

(f) Repeat foregoing procedure on right side mounting pad.

5. Install conduit elbow as follows: Refer to Figure 138.

(a) Draw a reference line on top right boxed-in section of the battery compartment which will be 1⅜ inches from the right inside side of the battery compartment and parallel thereto. Using 1⅝ inch circle saw, saw a hole on this line 3¼ inches from the rear of the front bulkhead of the battery box. After sawing chamfer forward and rear under sides of the hole by angling circle saw 20° in each direction.

(b) Drive a small nail through the battery box front bulkhead where the line drawn in paragraph (a) meets bulkhead. Using a square with edge on top edge of bulkhead draw a line on front side of bulkhead which will pass through the nail. Locate a point on this line 8⅛ inches from top edge of bulkhead. Using a 3-inch circle saw, saw hole through front panel of bulkhead and the supporting fillet between front and rear panels of bulkhead.

(c) Using same center as 3-inch hole, saw a 1⅝-inch hole through rear panel of bulkhead and fillet behind. Chamfer hole with same circle saw on upper inside of the hole by tilting hole saw upward.

(d) Using the unbeveled side of a ¾-inch firmer chisel, chamfer fillet supporting side of battery compartment to rear panel of bulkhead at a point about 1 inch above top of 1⅝-inch hole in bulkhead. Cut sufficiently to allow passage of radius of elbow of conduit. Clean out sawdust and chips with air or brush.

(e) Install conduit from front side of bulkhead. With flange seated on bulkhead panel secure conduit with four ⅝ inch x No. 6 round head wood screws.

6. Relocate battery heater terminals and battery lead clamp as follows: (Refer to Figure 138).

NOTE: Fuselages having three separate battery heaters in bottom of battery compartment do not require modification. Fuselages with single heater element require relocation of terminal screws.

(a) Carefully remove lead wires, terminal bolts and heater element.

(b) Drill two ⅝-inch holes in bottom of compartment each 4⅝ inches on right and left side of the longitudinal center line and ⅛ inch from the front inside of the battery compartment.

(c) Drill two holes with #9 twist drill 1⅝ inches from front inside of compartment and on same longitudinal lines as ⅝-inch holes were drilled. Counter-sink these holes on inside of compartment sufficiently to accommodate a #10 flat head screw.

(d) Mount terminal bolts and heater element previously removed in holes drilled. Heater strips are to be routed through new ⅝-inch holes. Place flat washer against wood. Terminal strip, lock washer, and hex nut follow in named sequence.

(e) Reconnect previously removed leads to newly located terminals.

(f) Mount 3064-F-5 clamp on front bulkhead of battery compartment shown in Figure 138 with screw. Exact location not important.

(g) Cut off right front corner of wood battery hold down clamp about 1 inch on each side of corner.

7. Modify bomb braces as follows: (Refer Figure 136).

NOTE: See special instruction under item (h), (p. 141), for fuselages bearing serial numbers less than 551.

(a) Turn fuselage upside down.

(b) Remove bomb brace angles from metal center section. Disassemble bars from angle sections.

(c) Drill a ⁹⁄₃₂-inch hole in each angle section in line with and midway between the holes by which the angles were mounted to the fuselage.

(d) Remount angles to fuselage center section in such manner that the angles are 1 inch forward from former position. This is accomplished by bolting the second hole in the angle with the first hole on the center section and the rear hole of the angle with the third hole from the front on the center section. Before mounting zinc chromate drilled holes for rust protection.

NOTE: In cases where the nuts of the hinge mounting bolts interfere with mounting grind off angle

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corner to provide proper clearance. Zinc chromate all surfaces where plating has been abrased on angles or metal center sections.

(e) Using mounted angles as templates, drill (use ⁵⁄₁₆-inch drill) forward and center holes of the angles through fuselage metal center section. Zinc chromate drilled holes. Install screws and bolts in holes drilled.

(f) Check if turnbuckles on bomb suspension straps are on *left* side of fuselage. (Don't forget fuselage is upside down, thereby reversing sides.) If not, unmount and remount so turnbuckles are on left side. Also check if clevis pin and bolt holding front bomb strap is inserted from bomb brace side.

(g) Mount corrugated bar on right side angle. Correct positioning of corrugated bar will be accomplished when bomb is actually installed.

(h) Special instructions for bomb braces on fuselages bearing serial numbers less than 551, obtain special bomb brace angles, bars and hardware from SWOD supply depot.

(1) Observe and accomplish foregoing section (f) if necessary.

(2) Remove bomb brace angles and bars completely. *No holes are to be drilled.*

(3) Install bomb brace angle without clinch nuts or corrugations on left side of fuselage using same hardward which mounted removed bomb braces.

(4) Mount bomb brace angle with clinch nuts and corrugations on right side. Also mount corrugated bar to right angle.

(i) Mount 3064–F–5 clamp with hardware provided as fuse holder. Locate as shown in Figure 138. Exact location not important.

(j) Turn fuselage over to normal position.

C. MODIFICATION OF COWLINGS:

1. Modify upper rear cowlings as follows: (Refer to Figure 139).

NOTE: Air stabilizers which have a tapered strip glued on the framework of the upper rear cowling do not require item (a), (b), D–6 or D–7, page 144.

(a) Remove hinge parts from sides of cowling. Do not remove front hinge parts.

(b) Sandpaper all paint and sealer from under side of cowling frame. (Part that rests on longerons of fuselage.)

(c) Using the supplied cowling strips (which will be glued and nailed in place later if steps (a) and (b) are required) as templates, mark extent of cowling frame which will have to be cut away. (Tack strips temporarily in proper location for marking purposes.)

(d) Remove splice plate on the forward side of the spanwise cowling frame member.

(e) Cut away cowling frame as per marking made in (c).

2. Modify lower cowlings as follows: (Refer to Figure 140.)

(a) Remove inertia switch arming coupling from the right side of the lower front cowling. Replace the mounting screws in mounting holes with nuts on inside. Fill large hole with supplied patch plate No. A6914–1024–1.

(b) Locate center of 4″ hole on *left* side of lower *front* cowling as per Figure 140. It will be noted on Figure 140 that the center of the hole is located at the intersection of a line scribed parallel to and 9¼ inches from the left member and a line scribed 5 inches from and parallel to the front edge of the cowling.

(c) Locate center of 4-inch hole on *right* side of lower *rear* cowling as per Figure 140. The center of the hole is located at the intersection of a line scribed parallel to and 16½ inches from the front edge of the cowling and a line scribed parallel to and 8 inches from the right frame member.

(d) Cut 4-inch holes with hole saw at center locations.

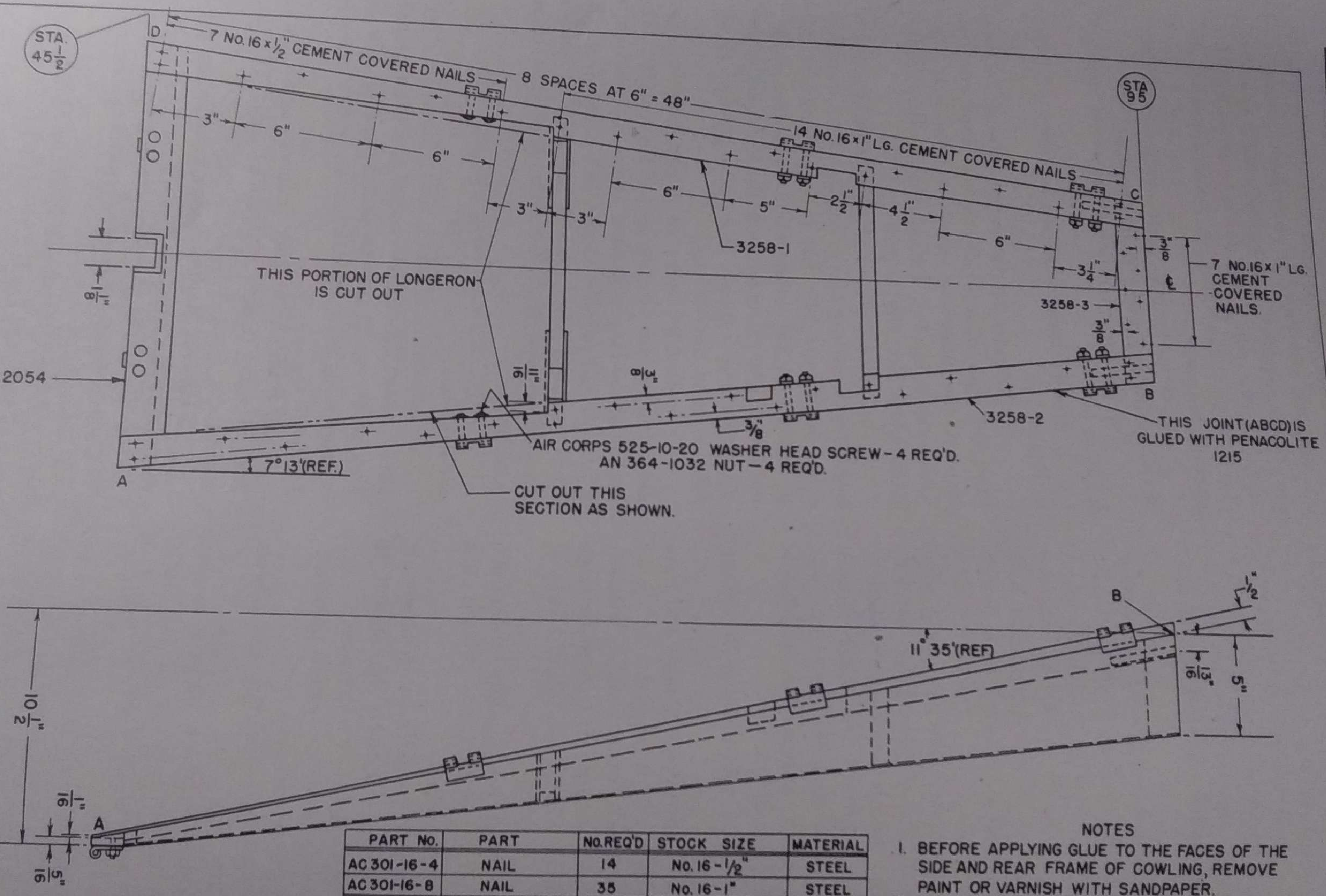
D. ASSEMBLY, GLUING, SEALING, AND PAINTING. **Note:** Immediate use of glue after preparation is necessary due to deterioration. For this reason all gluing operations have been grouped together.

1. Obtain mounting brackets and hardware for SWOD (Control System) Mk 18 to be mounted.

2. Prepare supplied glue powder as per instructions furnished.

3. Hold right side mounting pad in place with several screws in each control system mounting bracket.

(a) Glue and nail with two ¾-inch cement-coated nails the small filler strip in unused output arm extension. It will be noted two fillers are


STA. 45½
D
7 NO.16 x ½" CEMENT COVERED NAILS
8 SPACES AT 6" = 48"
14 NO.16 x 1" LG. CEMENT COVERED NAILS
STA 95
C
3"
6"
6"
3"
3"
6"
5"
2½"
4½"
6"
3¼"
3/8"
3/8"
℄
7 NO.16 x 1" LG. CEMENT COVERED NAILS.
3258-1
3258-3
3258-2
B
1/8"
THIS PORTION OF LONGERON IS CUT OUT
C 2054
1/16"
3/8"
3/8"
A
7°13'(REF.)
AIR CORPS 525-10-20 WASHER HEAD SCREW - 4 REQ'D.
AN 364-1032 NUT - 4 REQ'D.
CUT OUT THIS SECTION AS SHOWN.
THIS JOINT (ABCD) IS GLUED WITH PENACOLITE 1215
B
½"
11°35'(REF)
13/16"
5"
10½"
1/16"
A
5/16"

PART NO.	PART	NO. REQ'D	STOCK SIZE	MATERIAL
AC 301-16-4	NAIL	14	No. 16 - ½"	STEEL
AC 301-16-8	NAIL	35	No. 16 - 1"	STEEL
AN 364-1032	ELAST. STOP NUT	4	NO. 10-32	STEEL
525-10-20	WASH. HD. SCREW	4	NO. 10-32 x 1¼"	STEEL
3258-3	STRIP	1	½" x 1½" x 7¼"	POPLAR
3258-2	STRIP	1	½" x 1½" x 50 ⅞"	POPLAR
3258-1	STRIP	1	½" x 1½" x 50 ⅞"	POPLAR

NOTES

1. BEFORE APPLYING GLUE TO THE FACES OF THE SIDE AND REAR FRAME OF COWLING, REMOVE PAINT OR VARNISH WITH SANDPAPER.
2. ALL UNFINISHED WOOD SURFACES SHALL BE GIVEN ONE COAT OF SEALER AND EXTERIOR SURFACES SHALL BE PAINTED WITH SEA GRAY PAINT AFTER SEALER COAT APPLICATION.
3. ALL METAL SURFACES WHERE PLATING HAS BEEN DAMAGED BY CUTTING OR FILING SHALL BE PAINTED WITH ZINC-CHROMATE PAINT.

Figure 139—Assembly of Strips of Upper Rear Cowling.

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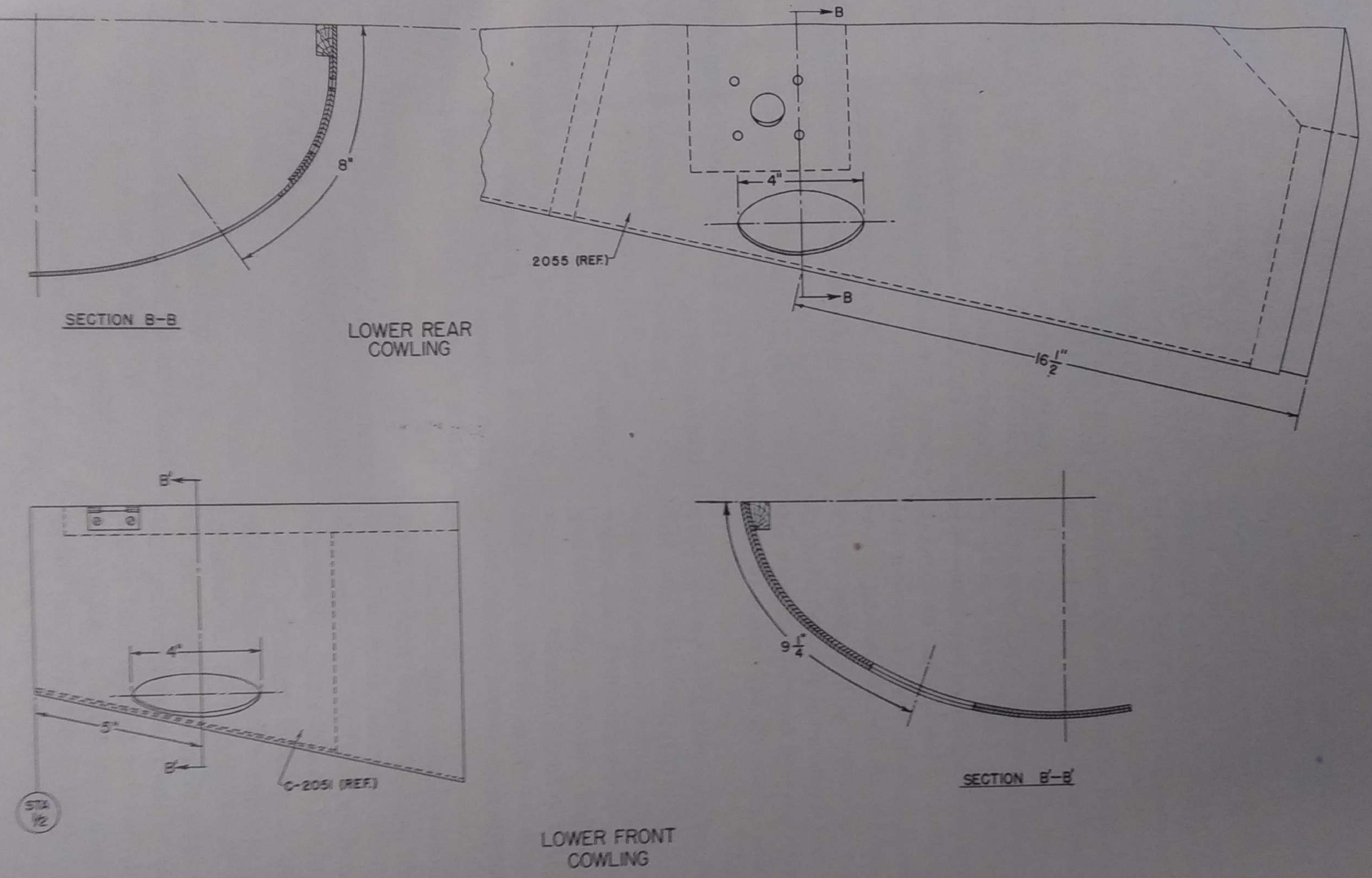

NOTE: ALL CUT SURFACES MUST BE SEALED
AFTER ASSEMBLY.

Figure 140—Alterations—Lower Front and Rear Cowlings.

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supplied with kit, one intended for fuselages with ⅛-inch slot and the other for fuselages with ⅜-inch slot.

(b) Remove mounting pad and redrill mounting hole where filler has covered hole.

4. Coat inside of fuselage where right and left pads will be glued and proper sides of mounting pads with glue. Mount pads in place using mounting control system bracket and hardware as clamps. Be sure washer plate is on outside of fuselage.

5. Drive provided cement coated nails in locations where pad and plywood skin tend to warp apart.

6. If cowlings require strips as per note under C-1, proceed as follows: Coat proper sides of provided upper rear cowling strips and frame face of cowling with glue. Place strips on cowling with thick end lined up with rear of cowling and edge even with outside of skin of cowling. Nail in place at points indicated with cement-coated nails. Also glue and nail provided center strip at rear of cowling with beveled edge in line with the rear edge of cowling. Saw off extensions of long strips if necessary.

7. If installation of cowling strips has been necessary as per the paragraph above, glue and nail supplied spacers (3/16 x 1⅛ x 3 inches) to under side of the outside frame members of each upper center cowling. Locate spacers under cowling mounting bolts. If it is found difficult to mount the suspension and hoisting devises on the suspension bar, the cowlings should be filed away at these points.

8. Remount forward side hinge sections on upper rear cowling with supplied washer head screws (AN525-10-20) inserted from inside of cowling and secured on surface of hinge with provided stop nuts (AN364-1032). Remount rear hinge sections in normal manner. **Note:** If new cowling strips have been installed the hinges will have to be remounted on the cowling. The new holes for mounting the hinges can be located by assembly of the removed cowling half to the fuselage half, locating the modified upper rear cowling in place and scribing outline of hinge on cowling. Drill holes for mounting screws with #9 twist drill. Mount hinge sections as described above.

9. Using sealer supplied, apply coat of sealer to the following locations:

(a) Slot cutout for new Venturi tube.

(b) New cutout made on inverter shelf.

(c) Enlarged output arm slots.

(d) Sandpapered surfaces on inside of fuselage around mounting pads.

(e) All cut surfaces on upper rear cowling. Also new strips added to upper rear cowlings and upper center cowlings.

(f) Cut edges of 4-inch holes made in lower front and rear cowlings.

10. Using zinc chromate paint, cover the following surfaces: Sawed off and tightened bolts at joining point of upper rear longerons and metal center section.

11. After sealer coat has dried sufficiently paint the following surfaces with provided sea gray paint.

(a) New Venturi cutout.

(b) Output arm slots and filler.

(c) Edges of 4-inch holes in lower cowling.

(d) Points where arming guides have been removed.

(e) Outside edges and facings of new upper cowling strips.

(f) Outside of remounted hinges.

(g) Any other scratched or open external surfaces.

(h) Outside surfaces of patch and/or inspection plates if not of matching color.

12. Install inspection and/or patch plates after surfaces have dried. If large inspection plates do not form to cowling satisfactorily reform for better fit.

13. After glue has thoroughly dried, remove control system brackets and hardware and retain with control system.

E. MODIFICATION OF REAR STABILIZER.

1. Remove round vertical stabilizers as follows:

(a) Withdraw pin from angle bracket and hinge part on horizontal stabilizer.

(b) Unbolt mounting hinges from vertical stabilizers.

2. Move horizontal stabilizer 4 inches aft as follows:

(a) Remove horizontal stabilizer fuselage

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mounting brackets. Retain all hardware with brackets.

(b) Locate provided template on horizontal stabilizer using hardware and brackets removed as holding means. (See Figure 133.)

(c) Drill pilot holes at points indicated with a small twist drill.

(d) After drilling pilot holes redrill holes to sizes indicated on template. Be sure final holes are drilled perpendicular to horizontal surface. Remove template.

(e) Remount fittings in new locations.

(f) Close up original holes with provided dowels. Use glue.

3. Mount triangular vertical fins as follows (Refer to Figures 134, 135, and 141):

(a) Secure the brace attached to the right vertical fin to the hinge part on horizontal stabilizer.

(b) Hold the fin against the horizontal stabilizer, raising or lowering until it is perpendicular to the top surface of the stabilizer. Also rotate fin until its trailing edge is perpendicular to the plane of the stabilizer. Figures 134 and 135 show method of attaining proper position by use of carpenter's square.

(c) With fin properly located spot holes for hinges.

(d) Drill holes spotted with No. 9/32 drill.

(e) Mount fin with supplied hardware. Use flat washer against outside wood surface fol-

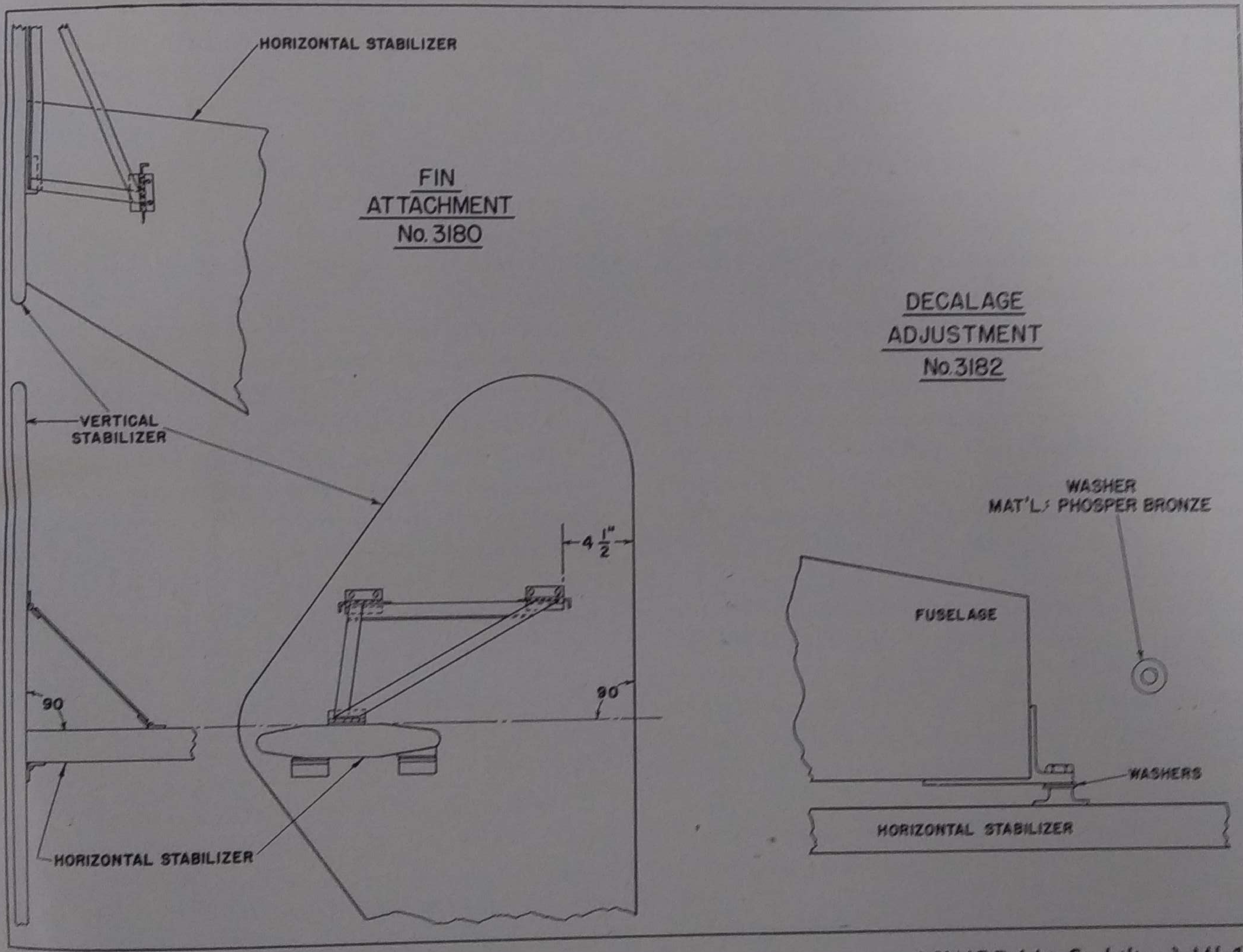

Figure 141—Relocation of Fin Attachment Assembly and Decalage Adjustment of SWOD (Air Stabilizer) Mk 13 Mod 1.

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lowed by lock nut. Recheck alignment before finally securing.

(f) Repeat (a) through (f) to mount left vertical fin.

(g) Repaint with sea gray paint uncovered surfaces on horizontal stabilizer, including remounted hinge parts and bolts on vertical fins.

(h) Attach shim washers supplied with kit to vertical fin angle bracket with wire. Washers will be used when stabilizer is mounted to fuselage and decalage adjustment is made.

V. Assembly of SWOD (Air Stabilizer) Mark 13 Mod 1 with Associate Equipment

With the foregoing modifications completed, the air stabilizer will be known as SWOD (Air Stabilizer) Mk 13 Mod 1. Assembly of the associated equipment with the air stabilizer is now possible. When completed, it will be known as SWOD Mk 9 Mod 1.

A. Mount SWOD (Control System) Mk 18 as Follows:

1. Mount *rear* control system mounting brackets so that screws are about two turns short of tight. Mount *front* brackets with *one* screw in lower front hole with screw loose enough to freely rotate brackets forward.

2. Turn control system output arms to glide position until the forked output arms are within the frame. Do not freeze linkage against frame. Note: The output arms are moved to position by turning the slotted shaft clockwise on top of right clutch (pitch) mechanism. If turning right clutch mechanism does not completely draw output arms inside, a small rotation of the left clutch (roll) mechanism will aid.

3. Lower control system slowly into fuselage by means of a mechanical or electric hoist. Note: Do not allow control system to come to rest on relays on lower rear or gyro assembly on the front of the control system. Further, do not allow output arms to swing out with possible subsequent damage.

4. With control system held in location rotate front mounting brackets to proper positions and bolt loosely.

5. Start slotted head cap screws with lock washers which secure control system to brackets. Use a screw-holding screwdriver to aid in *starting* rear screws. Tighten with socket wrench. After tightening the foregoing screws tighten bolts securing brackets to fuselage.

6. Adjust control system to neutral by manually operating pitch and roll clutches. Neutral position is obtained by *carefully* lining up scribed lines on shafts and bushings on under side of control system. It should be noted scribe lines appear on both pitch and roll output shafts and both must be lined up.

7. Remove starboard (painted green) shoulder screw from linkage. Pull output arms out through slots in fuselage. With a pair of pliers clamp welded slotted block on arm which serves as nut so slot is closed slightly. Place shoulder screws at elbows. The distorted slot acts as means of locking. Screws are dissimilar, therefore the color aid for proper location.

8. Place right elevon in position with neutral jig. Slide jig over the wing until the screw heads are held firmly on the plywod skin just forward of the elevon, and the forward V notch of the jig is centered on the leading edge of the wing. Moving the rear V notch against the trailing edge of the elevon, the neutral position is obtained. With control system and elevon in neutral, install and adjust push rod to proper length. Adjust rod end bearings so that free rotation will exist even at full extreme movements of elevon. Tighten lock nuts. Check for sufficient threads.

9. Repeat foregoing for left elevon.

10. Turn clutch shafts to obtain extreme movements of each elevon. At each extreme recheck freedom of rod end bearings. After check apply glyptol to threads.

11. Place short hose section and hose clamp on nipple on lower front of gyro so that thumb screw points upward. Tighten securely.

B. Install SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP–285 DPN–2 as Follows:

1. Route cable from directional control amplifier modification kit under inverter shelf and through front and rear triangle sections on left side of fuselage center section. Connect cable connector to connector on left front of control system. Also route long hose section from fuselage modification kit under inverter shelf and

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through front and rear triangle sections on right side of fuselage center section. Fasten open end to hose nipple on top to gyro, using provided hose clamp as means of securing. Cable clamp is to be mounted with thumb screw close to gyro. (See Figure 142 for routing of hose and cables to control system.)

2. Connect "Y" cable from power supply modification kit to bottom of power supply. Install power supply into fuselage, guiding cable through triangle section on right rear of metal center section. Connect connector of cable to right front connector on control system. Allow heavy leads and lead with fuse holder to drape under control system. Connect short hose length from gyro to fitting on power supply. Secure well. Fasten power supply in normal manner.

C. INSTALL BATTERIES AND CABLES AS FOLLOWS: (Refer to Figure 138).

1. Route heavy leads from power supply, supply leads of control system and the negative heater lead through conduit elbow. Be sure power supply leads will not be chafed by moving parts of control system. Assemble heater lead fuse holder with five-ampere fuse installed and clamp fuse holder into previously located clamp.

2. Install batteries as shown in Figure 138.

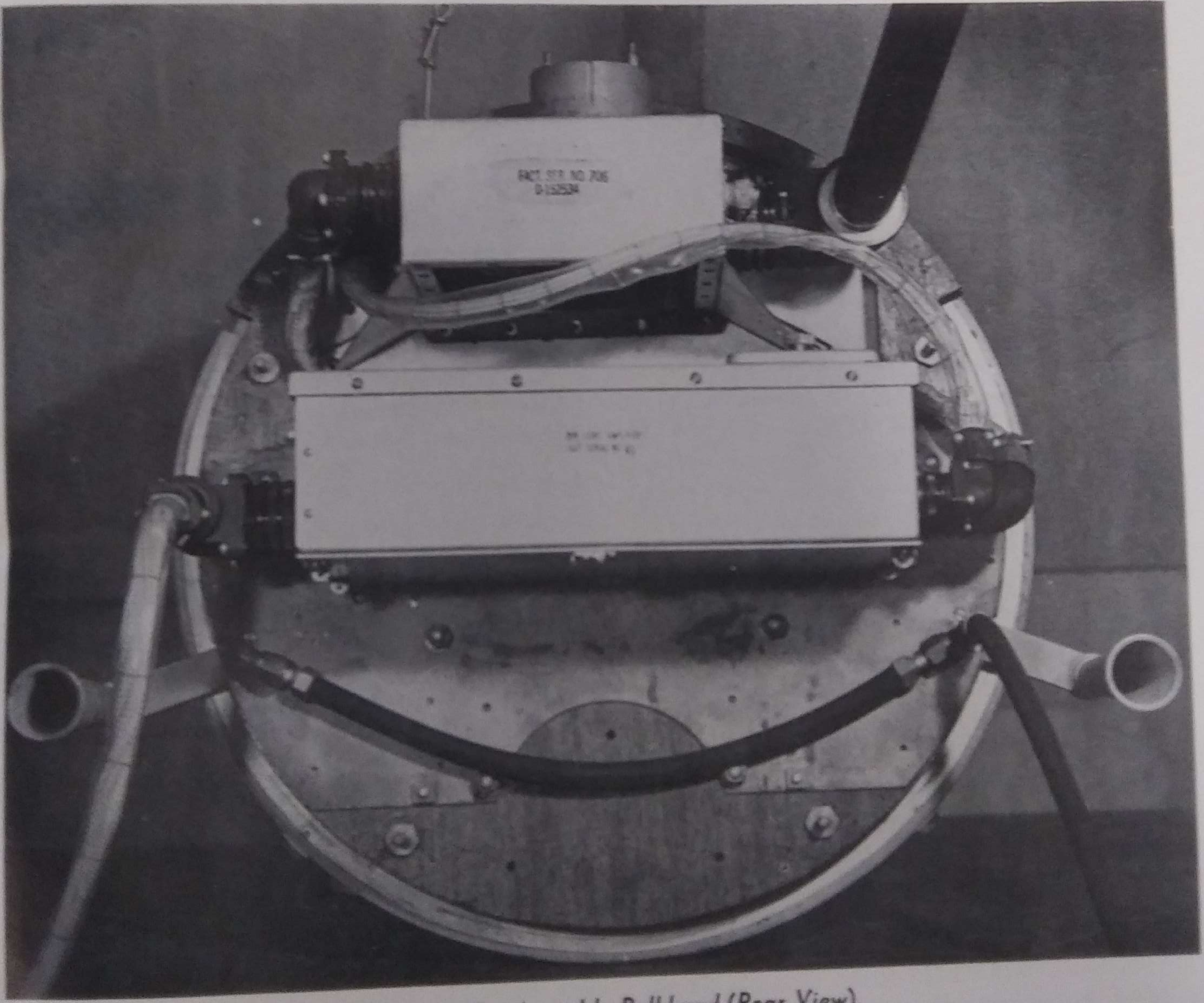

Figure 142—Assembly Bulkhead (Rear View).

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Connect leads as per Figure 138. Hold positive control system lead away from forward battery with cable clamp on battery compartment bulkhead. Tighten all battery terminal bolts.

D. Assemble SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2) to Bulkhead Assembly and Mount in Fuselage as Follows: (Refer to Figure 142.)

1. Obtain mounting studs for SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN-2) to be assembled to bulkhead.

2. Mount directional control amplifier to rear of bulkhead assembly with provided 10/32 x ⅜-inch slotted hex head screws and flat washers.

3. Install mounting studs into fuselage bulkhead mounting brackets. Mount bulkhead assembly on studs.

4. Connect spinner cable to connector on upper left hand side of radar bulkhead. Mount radar to bulkhead studs threading cable through hole in wood bulkhead. Secure with stop nuts.

5. Connect hose section from gyro to "T" fitting on right Venturi.

6. Connect remaining cables and ends of cables to proper connectors on radar junction box and directional control amplifier.

E. Install Rear Stabilizer as Follows: (Refer to Figure 141.)

1. Mount rear stabilizer in normal manner. Check decalage. If more or less than 2°±15′ adjust as follows: If decalage is too great decrease with shim washers previously attached to vertical fin angles. If decalage is too small increase by filing top surface of decalage spacers on mounting bracket.

Note: For each 0.004 inch that the horizontal stabilizer is raised or lowered at the rear attachment bolt, with respect to the fuselage, the decalage is increased or decreased by one minute.

2. If instructions for measuring decalage have not been available, proceed as follows, using the decalage gauge:

Note: The decalage of the air stabilizer is the angle between the projected chord of the wing and the projected chord of the tail. For the SWOD (Air Stabilizer) Mk 13 the chord of the tail must be tilted downward with respect to the chord of the wing. The average of readings taken on the right side and on the left side is considered to be the decalage of the air stabilizer. It is suggested that the decalage be measured on the chords of the wing and rear stabilizer at the position indicated by the heavy lines.

(a) Support air stabilizer rigidly and place elevons in neutral position as previously described.

(b) Release the pointer of decalage gauge by backing off the knurled locking screw and relock with the scribed line on the pointer at zero degrees on the scale.

(c) Hold the gauge firmly on the left wing with the fixed "V" notch on the indicating line at the leading edge, and the sliding "V" notch over the indicating line at the trailing edge of the elevon. During the measurements, the gauge must be held in a vertical position.

(d) Adjust the level glass by turning the knurled screw on the level glass mounting until the level glass is balanced.

(e) Transfer the gauge to the indicated position on the left side of horizontal stabilizer; release the pointer and move pointer down until the level glass indicates a level position. The decalage for that side of the airframe may be read directly from the scale.

(f) Repeat for the right side of the airframe. Add the readings for the two sides and divide by two. Example:

Left decalage (wing to stabilizer)	2°15′
Right decalage (wing to stabilizer)	1°52′
	4°07′

$$\text{Average decalage} = \frac{4°07'}{2} = 2°03'+$$

3. Adjust radar spinner angle as follows:

(a) With pointer on decalage gauge locked at 0°, set decalage gauge on left wing in same manner as for decalage setting.

(b) Adjust level glass to a balanced position.

(c) Remove gauge from left wing and place on right wing. Release pointer and move until level glass indicates a level position. The resultant difference from 0° is known as the angular divergence of the wing. When divided by two, the result will be the average divergence. Note average divergence in plus or minus figures.

(d) With decalage gauge remaining on right wing, attach spinner gauge attachment on front of decalage gauge by means of knurled screws. Set pointer to required spinner angle setting which is three times the average decalage minus the average divergence of the wing. (This calculation is made algebraically. Adjust level on spinner gauge to a balanced position.) Example:

Wing divergence:

Left wing 0° Right wing +16′

Average divergence $\frac{+16'}{2}=8'$

$3\times2°3'=6°9'-(+8')=6°1'$ (referred to right wing)=spinner angle setting.

(e) Remove spinner gauge attachment from decalage gauge and hold firmly against the driving gear on the spinner. Make sure gauge is flush against surface and that there are not obstructions such as screws or burrs. With gauge held in position, have assistant adjust spinner until level glass returns to balanced position. The spinner adjustment is made by loosening the upper spinner frame clamp and then moving the lock nuts along the swivel bolt at the bottom of the spinner frame. Turn all bolts to proper tightness and safety with wire.

> NOTE: Occasional check of the alignment of the frame angle and the pointer angle at the front of the decalage gauge should be made. Make check of alignment with pointer set at 0°.

F. SECURE AIR STABILIZER TO BOMB AS FOLLOWS:

1. Remove corrugated bomb brace on left side of fuselage. Unlatch bomb cinch straps on side.

2. Place bomb with fuzes installed on dolly so that bomb suspension lugs are on right side and in a horizontal position with respect to the bomb center.

3. Hoist air stabilizer sufficiently to allow bomb on dolly to be pushed under. Lower air stabilizer slowly, noting the following:

(a) Bottom of power supply should have small clearance from top of bomb.

(b) Inverter shelf should be clear of bomb.

(c) Lowest point on gyro should be about ⅜ inch above the bomb.

(d) Right bomb brace extremities are between suspension lugs.

4. With air stabilizer firmly seated on bomb, remount corrugated bar of left side with cut-out section holding bomb lug.

5. Fasten bomb straps and cinch to proper tightness. If clearance of any of the above is not adequate, hoist air stabilizer and adjust screws on bomb support angles of air stabilizers center section. Do not make too great adjustments. If adjustment is made properly secure lock nuts on screws.

G. SECURE COWLINGS IN NORMAL MANNER. NOTE: If rear part of lower front cowling will not fit, it may be necessary to raise bomb by unscrewing adjustment screws slightly then recinching bomb. Clearance given under section 5 must be maintained. Lower center cowling may bind if hoisting lug on bomb is not well up in notch of bomb brace.

H. SERVICING OF FUZES AND COUPLINGS. Servicing of bomb fuzes must be accomplished from under side of airframe, removing cowlings if complete access is necessary. The bomb fuze arming device coupling must be connected to the arming pin through inspection plates.

Caution: Handling of fuzes and arming couplings should be done only by personnel trained in servicing these devices.

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SERIAL NUMBERS OF SWOD (AIR STABILIZER MK 13 MOD 0) WITH DEFECTIVE ELEVON HORNS

Replace with Part C–3507B to be obtained from Supply Depots

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
259	492	598	683	754	945	1145	1252	1313	1360
356	493	599	684	756	946	1148	1253	1314	1361
362	494	600	685	757	952	1151	[1] 1254	1315	1362
366	495	601	686	758	954	1155	1255	1316	1363
370	496	602	688	759	961	1156	1256	1317	1364
372	498	603	690	760	979	1158	1257	1318	1365
373	499	604	700	763	991	1160	1258	1319	1366
376	500	605	703	764	996	1164	1259	1320	1367
378	501	606	706	765	999	1165	1260	1321	1368
381	503	608	707	766	1000	1169	1261	1322	1370
382	505	609	708	768	1001	1170	1262	1323	1371
384	507	610	710	771	1003	1173	1263	1324	1372
385	509	612	711	773	1007	1174	1264	1325	1373
387	516	614	712	785	1009	1176	1265	1326	1374
388	517	616	713	786	1011	1181	1266	1327	1375
393	520	619	714	788	1014	1182	1267	1328	1376
403	522	620	716	789	1016	1183	[1] 1268	1329	1377
405	523	621	717	791	1017	1184	1269	1330	1378
409	524	622	719	792	1020	1185	1270	1331	1379
415	525	623	721	794	1021	[1] 1186	1271	1332	1380
416	529	624	722	799	1022	1188	1272	1333	1382
417	530	626	723	802	1023	1189	1273	1334	1383
421	531	629	725	804	1024	1190	1274	1335	1384
422	532	630	726	817	1026	[1] 1191	1275	1336	1385
432	535	631	727	842	1031	1193	1276	1337	1386
436	537	633	728	843	1036	1194	1278	1338	1387
437	540	635	729	844	1041	1199	1279	1339	1388
443	541	637	730	847	1042	1203	1280	1340	1390
446	542	641	731	859	1044	1207	1284	1341	1391
447	577	648	734	860	1045	1218	1285	1342	1392
450	578	653	736	869	1049	1226	1286	1343	1395
451	579	655	737	871	1050	1227	1287	1344	1396
455	586	662	738	885	1052	1233	1289	1346	1397
458	587	665	739	892	1055	1235	1290	1347	1401
467	588	667	740	893	1056	1241	1291	1348	1402
468	589	668	741	899	1057	1243	1294	1349	1403
469	590	670	742	909	1058	[1] 1244	1298	1350	1404
470	591	671	743	929	1059	[1] 1245	1299	1352	1408
473	592	673	745	935	1060	[1] 1246	1300	1353	1413
474	593	674	746	936	1061	1247	1306	1354	1439
476	594	675	747	937	1120	1248	1309	1356	1445
479	595	677	748	939	1139	1249	1310	1357	
482	596	679	749	941	1140	[1] 1250	1311	1358	
483	597	682	753	943	1143	[1] 1251	1312	1359	

[1] Less servo.

VI. Illustrations

Figure 75. Control System Installed
Figure 133. Template Location On Horizontal Stabilizer
Figure 134. Spanwise Alignment Of Vertical Fin Surface With Reference To Horizontal Stabilizer Surface
Figure 135. Method of Alignment Of Trailing Edge Of Fin With Reference To Horizontal Stabilizer Surface
Figure 136. Cutout In Inverter Shelf And Modification Of Bomb Brace
Figure 137. Modification Of Servo Compartment
Figure 138. Battery Box Modification
Figure 139. Assembly Of Strips Of Upper Rear Cowling
Figure 140. Alterations—Lower Front and Rear Cowlings
Figure 141. Relocation Of Fin Attachment Assembly and Decalage Adjustment of SWOD (Air Stabilizer) Mk 13 Mod 1
Figure 142. Assembly Bulkhead—Rear View

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Appendix C

TEST EQUIPMENT

TEST UNIT MK 30 MOD 0

Purpose: The purpose of Test Unit Mk 30 Mod 0 shown in Figure 143 is to check the main functions of the SWOD (Control System) Mk 18 Mod 1 with or without the SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN–2) and SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP–285/DPN–2). Figure 144 is a wiring diagram of Test Unit Mk 30 Mod 0.

Additional equipment required for test:

1. SWOD (Control System) Mk 18 Mod 1.
2. SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN–2).
3. SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP–285/DPN–2).
4. 28-volt battery. **Note:** In normal field test the foregoing equipment is the assembled SWOD Mk 9 Mod 1.

Cable connections: The two cables that normally go to J–1901 and J–1902 of the SWOD (Control System) Mk 18 Mod 1 are connected to the test unit. Two new cables are provided to connect these two connectors to the test unit. A two-wire cable is provided to connect a 28-volt battery to the test unit.

Description of controls:

1. "NORMAL TEST" Switch. When the NORMAL TEST rotary switch is in NORMAL position, normal operation of the SWOD (Control System) Mk 18 Mod 1 with the SWOD (Radar) Mk 2 Mod 2 (Radar Set AN/DPN 2) is possible. In the TEST position the functions of the control system may be controlled by the test unit without use of the radar.

2. 250-VOLT SUPPLY Switch. The 250-VOLT SUPPLY switch in the GLIDER position supplied 250 volts to the control system from the SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP–285/DPN–2). In the OFF position the 250 volts is off. In the AUX position 250 volts is supplied to the control system from the dynamotor built into the test unit. **Note:** The 250-volt supply is protected by a 0.5 amp. H. V. FUSE in the test unit and a test point hole is provided in the fuse holder cap for measuring this voltage.

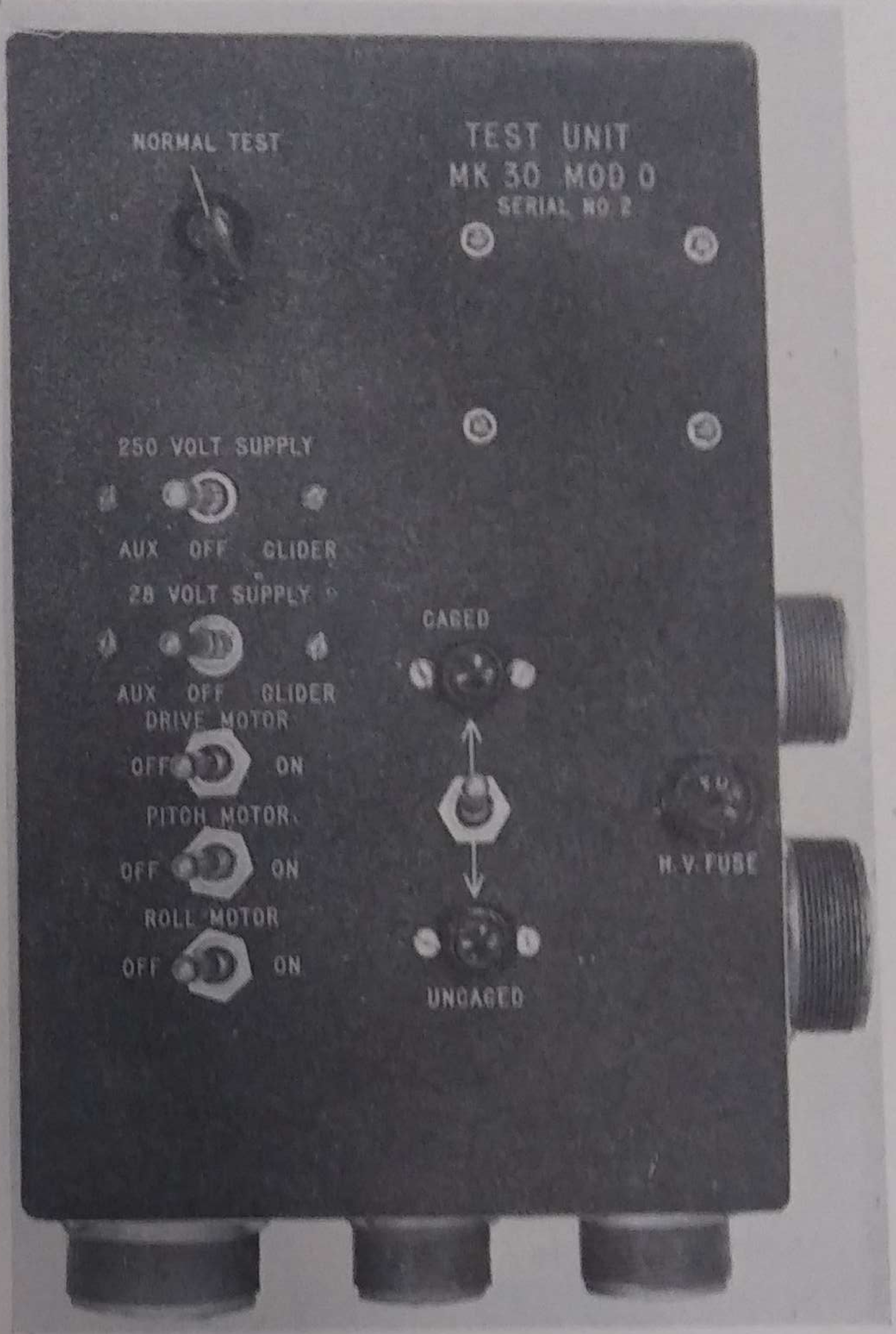

Figure 143—Test Unit Mk 30 Mod 0.

3. 28-VOLT SUPPLY Switch. The 28-VOLT SUPPLY switch in GLIDER position supplied 28 volts to the control system from the SWOD (Power Supply) Mk 16 Mod 2 (Power Supply PP–285/DPN–2). In the OFF position the 28-volt supply is off. In AUX position the 28 volts are supplied by the auxiliary 28-volt battery connected to the test unit.

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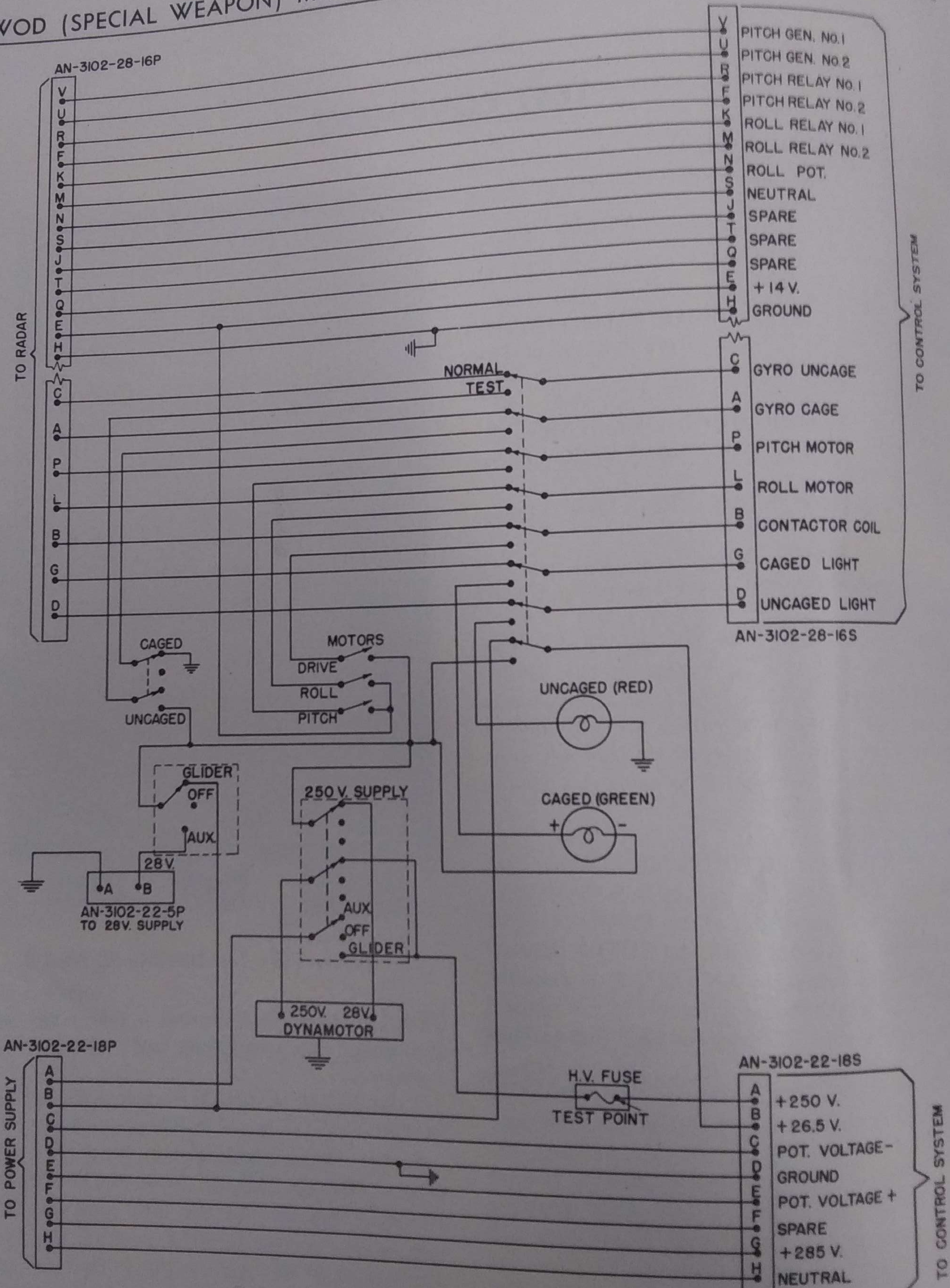

Figure 144—Wiring Diagram of Test Unit Mk 30 Mod 0.

4. DRIVE MOTOR Switch. The DRIVE MOTOR switch, when the NORMAL-TEST switch is in the TEST position, controls the contactor coil in the control system to operate the drive motor.

5. ROLL MOTOR Switch. The ROLL MOTOR switch, when the NORMAL-TEST switch is in the TEST position, controls the roll motor in the control system.

6. PITCH MOTOR Switch. The PITCH MOTOR switch, when the NORMAL-TEST switch is in the TEST position, controls the pitch motor in the control system.

7. CAGED-UNCAGED Switch. The CAGED-UNCAGED switch, when the NORMAL-TEST switch is in the TEST position, controls the gyro caging motor in the control system.

8. Pilot Lights. The CAGED and UNCAGED lights, when the NORMAL-TEST switch is in the TEST position, indicate the position of the gyro caging mechanism.

TEST UNIT MK 31 MOD 0

Purpose: The purpose of the Test Unit Mk 31 Mod 0 shown in Figure 145 is to test the caging, uncaging and firing circuits of the SWOD Mk 9 Mod 1 and the ready and firing circuits of the SWOD Mk 9 Mod 0. Primarily its function is the same as the armament switch box used in plane.

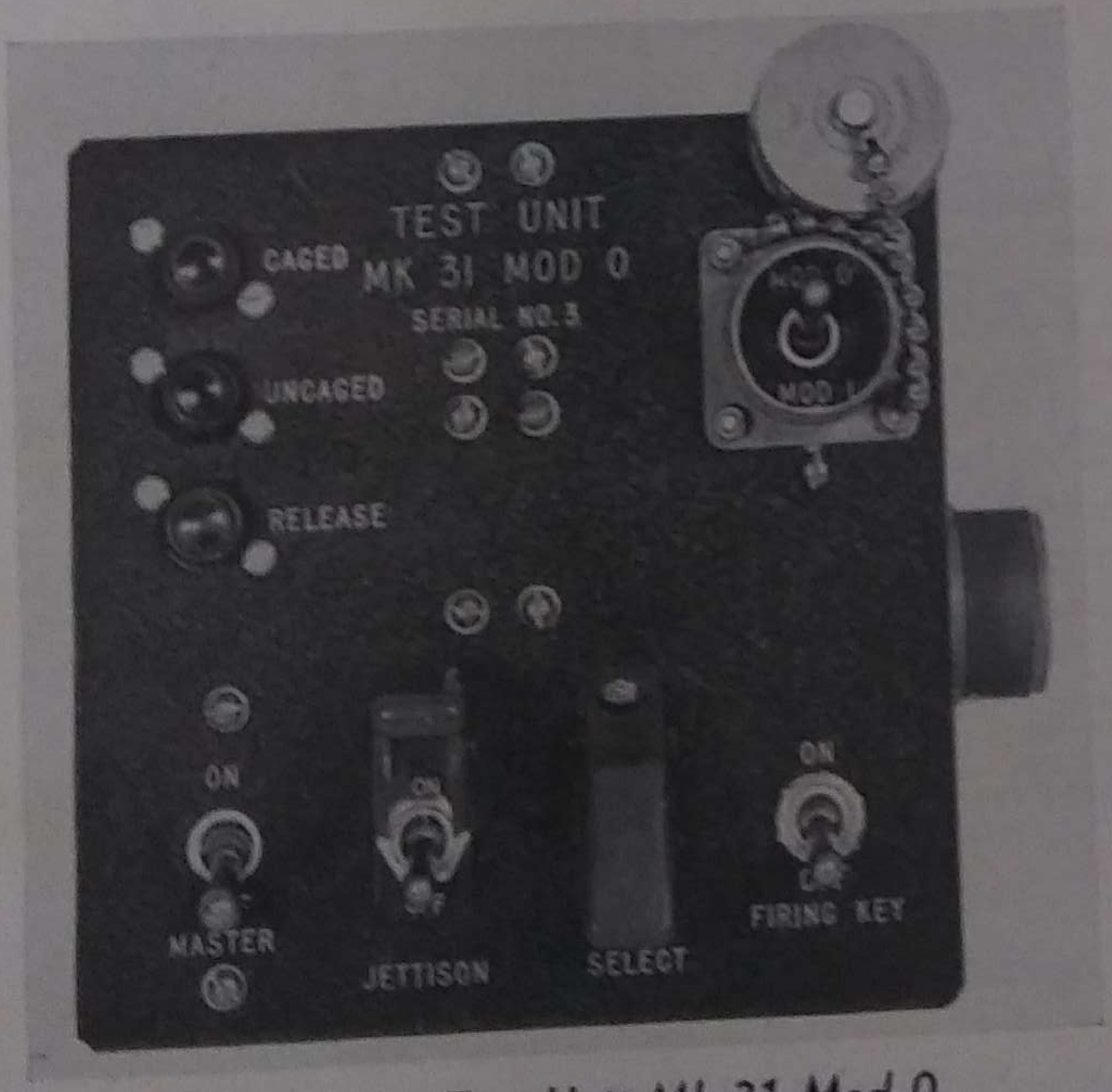

Figure 145—Test Unit Mk 31 Mod 0.

A control circuit schematic for a single channel monitor is shown in Figure 146.

Additional equipment required for test:

1. SWOD (Radar) Mk 2 Mod 1 or Mod 2 (Radar Set AN/DPN-1 or 2) and associated equipment for normal operation or complete SWOD Mk 9 Mod 0 or 1.

2. Aircraft control equipment modified for SWOD Mk 9 Mod 1 or improved Mod 0; i. e., harness installed in connection box as described further on in this section.

Cable connection: The test unit is provided with one cable which is used to connect it to J-1306 of modified Connector Box Mk 6 Mod 0, Mk 5 Mod 1 (Junction Box J-233/APA-65) or Mk 5 Mod 2 (Junction Box J-234/APA-66). If a Connector Box Mk 5 is used it is necessary that the SWOD Mk 9 under test be connected to the port channel.

Description of Controls:

1. MOD 0—MOD 1 Switch. The MOD 0—MOD 1 switch is provided so that the test unit may be used with either SWOD Mk 9 Mod 0 or SWOD Mk 9 Mod 1.

2. MASTER Switch. The MASTER switch supplies plane power to all indicating, arming and release functions except the CAGED gyro light which is connected to the input side of the MASTER switch.

3. JETTISON Switch. The JETTISON switch which by-passes the ready relay and gyro circuits is provided to test the emergency release circuit.

4. SELECT Switch. The SELECT switch completes the circuit in the test unit to the release relay. This relay breaks the circuit to the RELEASE light when conditions for release have been satisfied.

5. FIRING KEY. The FIRING KEY switch simulates the firing key that normally releases the SWOD Mk 9 and is used to check the release circuit.

6. PILOT LIGHTS.

a. Mod 0 Operation. The CAGED light is never lighted. The UNCAGED light is lighted when the monitor switch is thrown to "G". The RELEASE light is lighted when the MASTER switch is ON and goes out immediately when the FIRING KEY switch is turned ON if the

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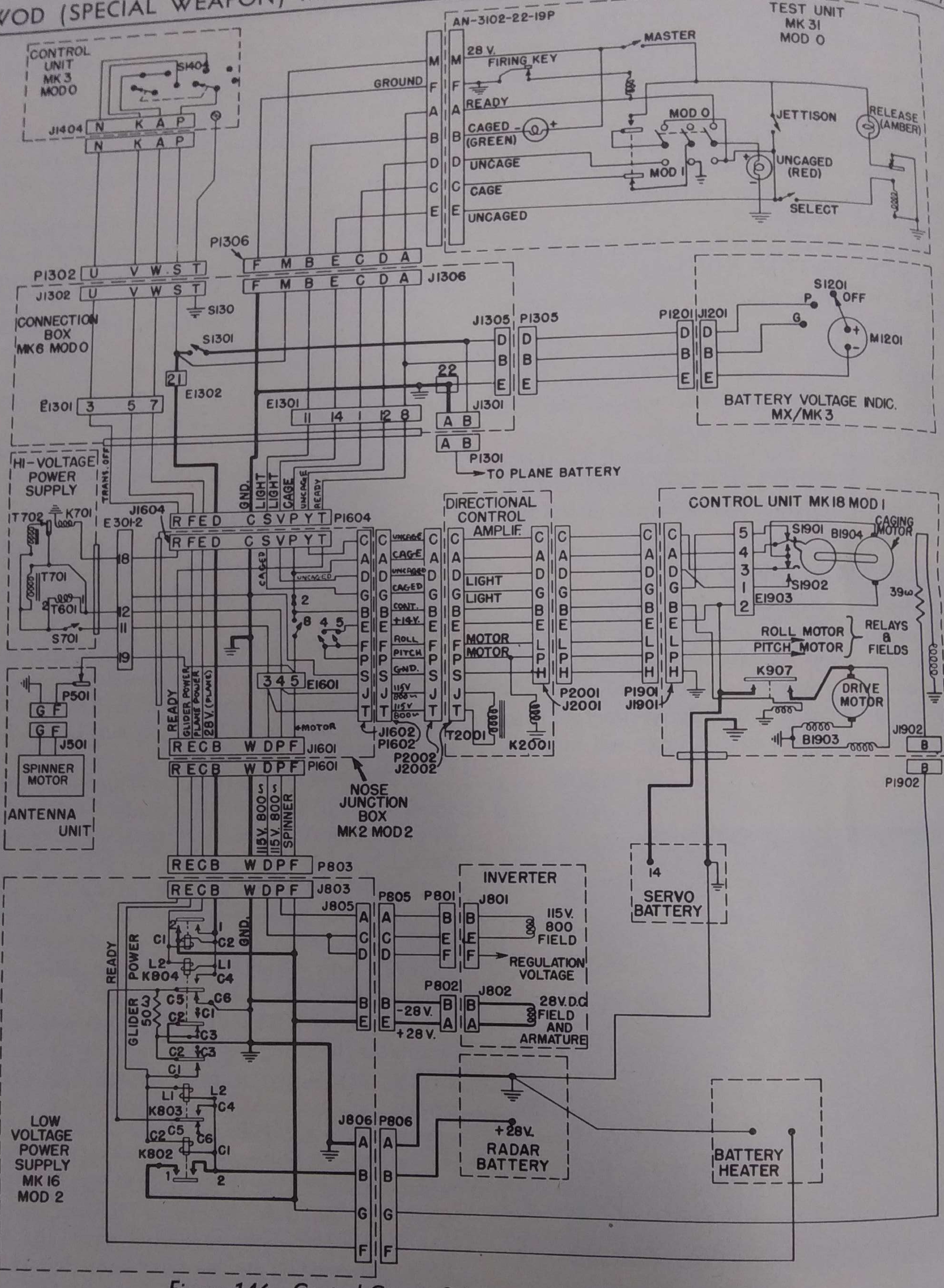

Figure 146—Control Circuit Schematic for SWOD Mk 9 Mod 1.

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proper switches have been thrown to release the SWOD Mk 9 Mod 0.

b. Mod 1 operation. The CAGED light shows when the gyro is caged. The UNCAGED light shows when the gyro is uncaged. The RELEASE light is lighted when the MASTER switch is ON and goes out three seconds after the FIRING KEY switch is turned ON if the proper switches have been thrown to release the SWOD Mk 9 Mod. 1.

Testing SWOD Mk 9 Mod 0

NOTE: Throw the MOD 0–MOD 1 switch to MOD 0 before connecting test unit.

Important note: The covered MOD 0–MOD 1 switch must be in the proper position for type of unit being tested.

If the switch is in the MOD 1 position with a SWOD Mk 9 Mod 0, slewing will be impossible when the power switch on monitor is thrown to PLANE power position. Also the CAGED light will either light or burn out if the SWOD Mk 9 Mod 0–115-volt a-c source from inverter (Pin "S" or "Y" of breakaway connector J1604) is grounded. *All Mod 0 systems must be checked to insure that neither "S" or "Y" is grounded.*

The following test procedure is to be followed:

1. With all test unit switches OFF and the Monitor Mk 2 or Mk 3 power switch in "P" position, no indicator light should be lighted.

2. Throw the power switch on the monitor to "G" (marked READY on Monitor Mk 2 Mod 2 (Control Group AN/APA–66)). The UNCAGED light should be lighted indicating the SWOD Mk 9 Mod 0 is in ready stage. The CAGED and RELEASE lights should not be lighted.

3. Throw MASTER switch ON. The RELEASE light should light.

4. Throw SELECT switch ON. Lights should remain unchanged.

5. Throw FIRING KEY switch ON. Release light should go out immediately.

6. Throw FIRING KEY switch OFF. Release light should relight.

7. Throw JETTISON switch ON. Release light should go out immediately.

Testing SWOD Mk 9 Mod 1

Note: Throw the MOD 0—MOD 1 switch to MOD 1 before connecting the test unit.

Important Note: The covered MOD 0–MOD 1 switch must be in the proper position for the type of unit being tested.

If the switch is in the MOD 0 position with a SWOD Mk 9 Mod 1 the RELEASE light will go out immediately when the FIRING KEY switch is turned ON instead of a three-second delay for the gyro to uncage.

The following procedure is to be followed:

1. With all test unit switches OFF and the Monitor Mk 2 or Mk 3 power switch in "P" position the CAGED light should be lighted and the other two lights off.

2. Throw power switch on monitor to G (marked READY on monitor Mk 2 Mod 2 (Control Group AN/APA–66)). The CAGED light should remain lighted and the other two off.

3. Throw MASTER switch ON. The RELEASE light should light.

4. Throw SELECT switch ON. Lights should remain unchanged.

5. Throw FIRING KEY switch ON. The CAGED light should go out and three seconds later (after gyro has uncaged) the UNCAGED light should light and the RELEASE light go out.

6. Throw FIRING KEY switch OFF. RELEASE light should light and UNCAGED light should go out, and three seconds later the CAGED light should relight.

7. Throw JETTISON switch ON. The RELEASE light should go out and both the CAGED and UNCAGED lights should be lighted. (The gyro will remain caged. The UNCAGED light is lighted through the JETTISON switch.)

Modification of Connection Box for use with Test Unit Mk 31

A connection box harness is provided with each Test Unit Mk 31 Mod 0. This harness must be installed in connection box. (Figure 148). The connector of the connection box harness should be mounted as shown on Figures 149 and 150. Connector is mounted on center line of nameplate with edge of connector ¹⁄₁₆ inch from edge of nameplate. (See Figure 147.)

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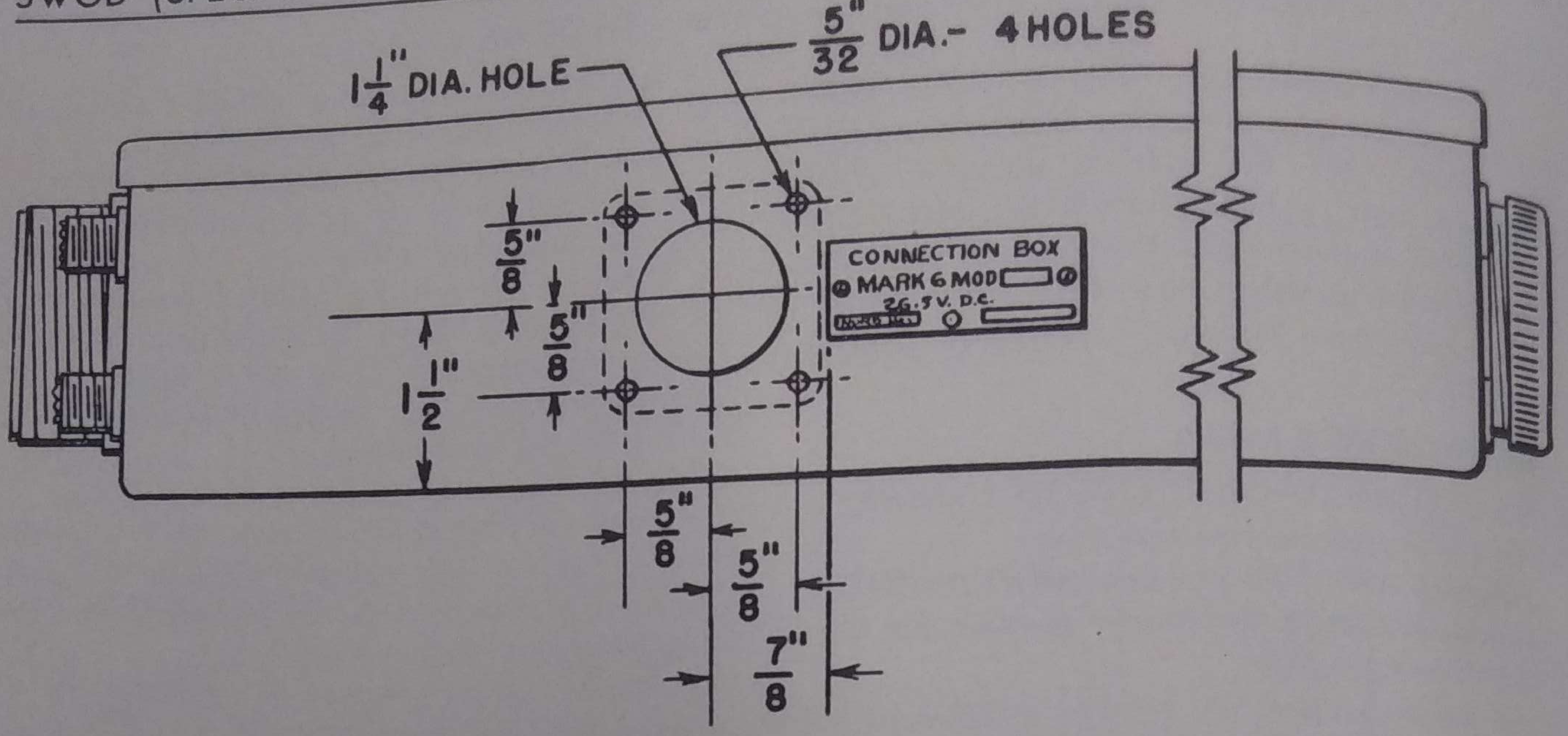

Figure 147—Mounting Location of Connection Box Harness Connector.

The wiring procedure for each type of connection box is as follows:

1. Connection Box Mk 6 Mod 0 (Single Channel).

(a) Clip and remove the five shorter laced wires of the harness at the connector.

(b) The remaining leads will go to terminals 1, 8, 11, 12, and 14 of E–1301.

(c) The long single lead will go to ground terminal 22. The short single lead is to be connected to the terminal on circuit breaker S–1301 which carries the plus 28 volts from plane bus.

(d) At the time modifications are being made it is recommended that auxiliary grounding be installed between Rack MT/Mk 3 (Rack MT–566/APA–67) and Connection Box Mk 6 Mod 0.

(1) If cables are already made, a ground lead (#16 Std. insulated wire) should be run from a ground stud mounted (in a convenient location with respect to external cabling) on Connection Box Mk 6 Mod 0 to a satisfactory ground point on Rack MT/Mk 3 (Rack MT–566/APA–67). This auxiliary lead can be wrapped around routed with cable between the two units.

(2) If cable has not been made, a ground lead should be installed between terminal "T" on P1302 and satisfactory grounding point on Rack MT/Mk 3 (Rack MT–566/APA–67). This lead can be routed with cable to cable clamp on P–1404. **Note:** Use of revised cable on Monitor Mk 2 Mod 1 will eliminate range meter information.

2. Connection Box Mk 5 Mod 2 (Junction Box J–234/APA–66) (Double Channel).

(a) The five longer wires of the harness are to be connected to terminals 1, 8, 11, 12, and 14 of terminal strip *E–1301*. This will be the PORT channel on the armament switch box which is also channel "A" of Monitor Mk 2 Mod 2.

(b) The five shorter wires of the harness are to be connected to terminals 1, 8, 11, 12, and 14 of terminal strip E–1302. This will be the STARBOARD channel on the armament switch box and channel "B" of Monitor Mk 2 Mod 2.

(c) Refer to paragraph 1(c) in column 1 for connection of remaining single leads of harness.

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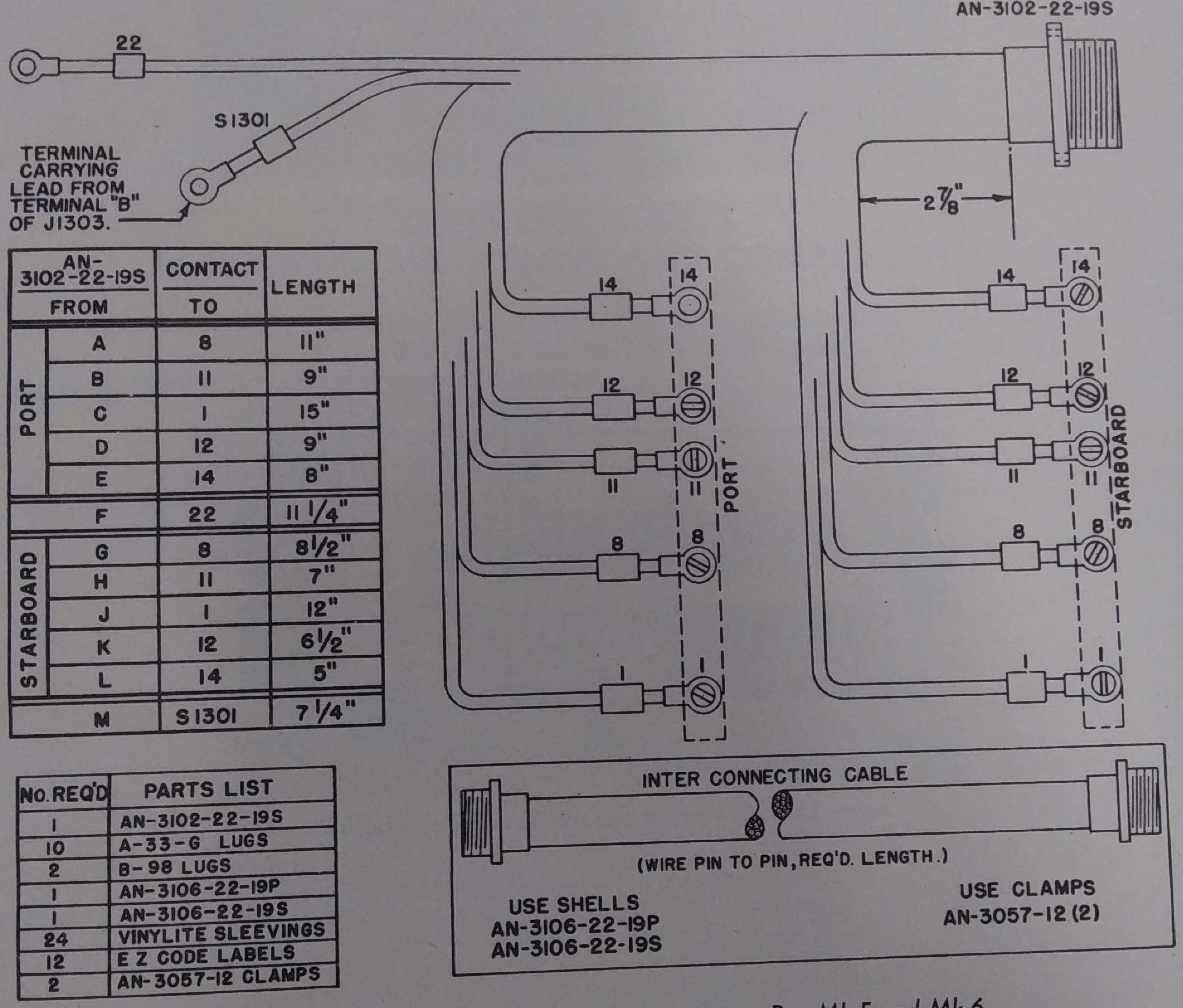

	AN-3102-22-19S FROM	CONTACT TO	LENGTH
PORT	A	8	11"
	B	11	9"
	C	1	15"
	D	12	9"
	E	14	8"
	F	22	11 1/4"
STARBOARD	G	8	8 1/2"
	H	11	7"
	J	1	12"
	K	12	6 1/2"
	L	14	5"
	M	S1301	7 1/4"

NO. REQ'D	PARTS LIST
1	AN-3102-22-19S
10	A-33-G LUGS
2	B-98 LUGS
1	AN-3106-22-19P
1	AN-3106-22-19S
24	VINYLITE SLEEVINGS
12	E Z CODE LABELS
2	AN-3057-12 CLAMPS

Figure 148—Harness for Modification of Connection Box Mk 5 and Mk 6.

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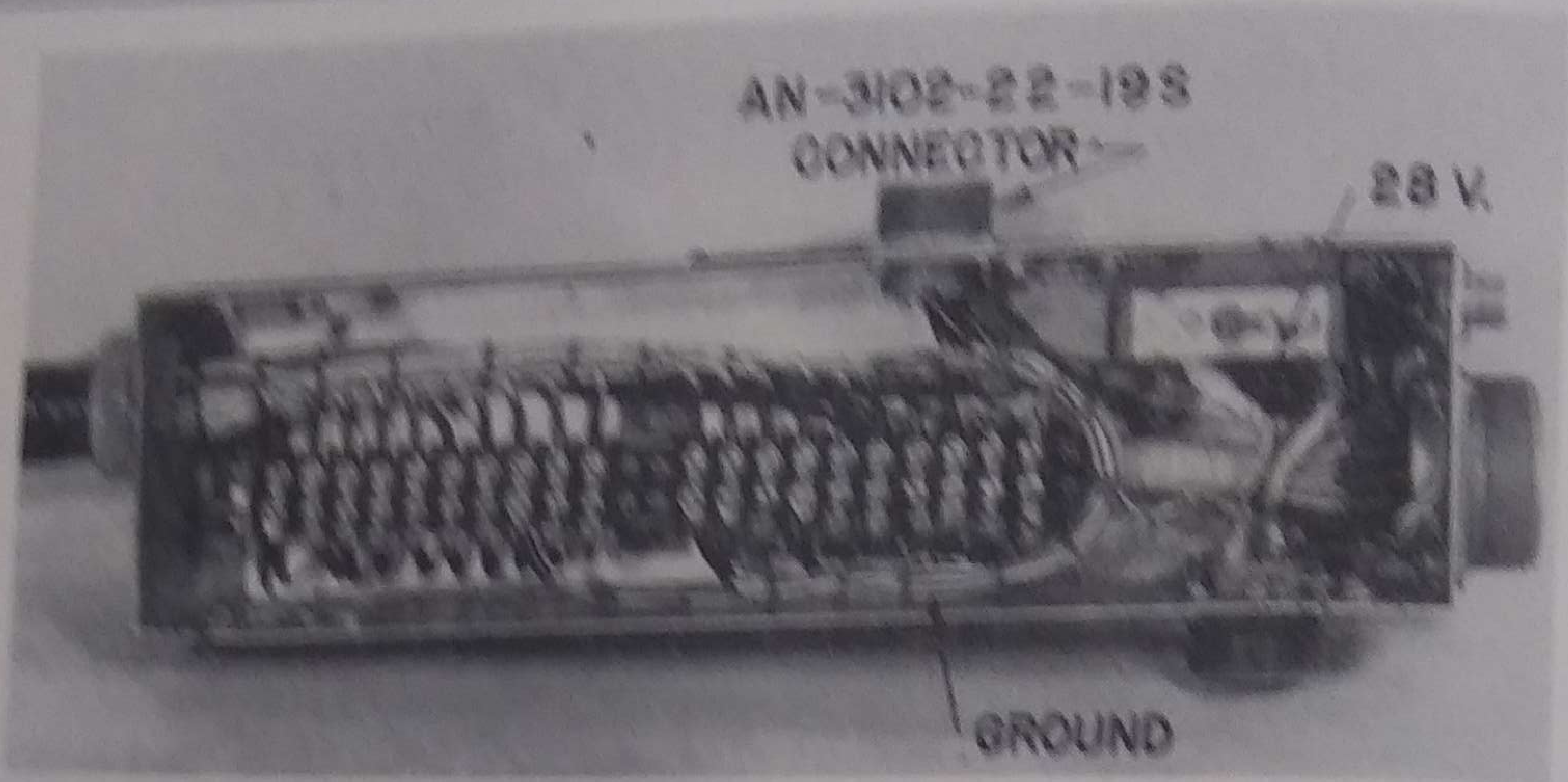

Figure 149—Connection Box Mk 6 Mod 0 as Modified.

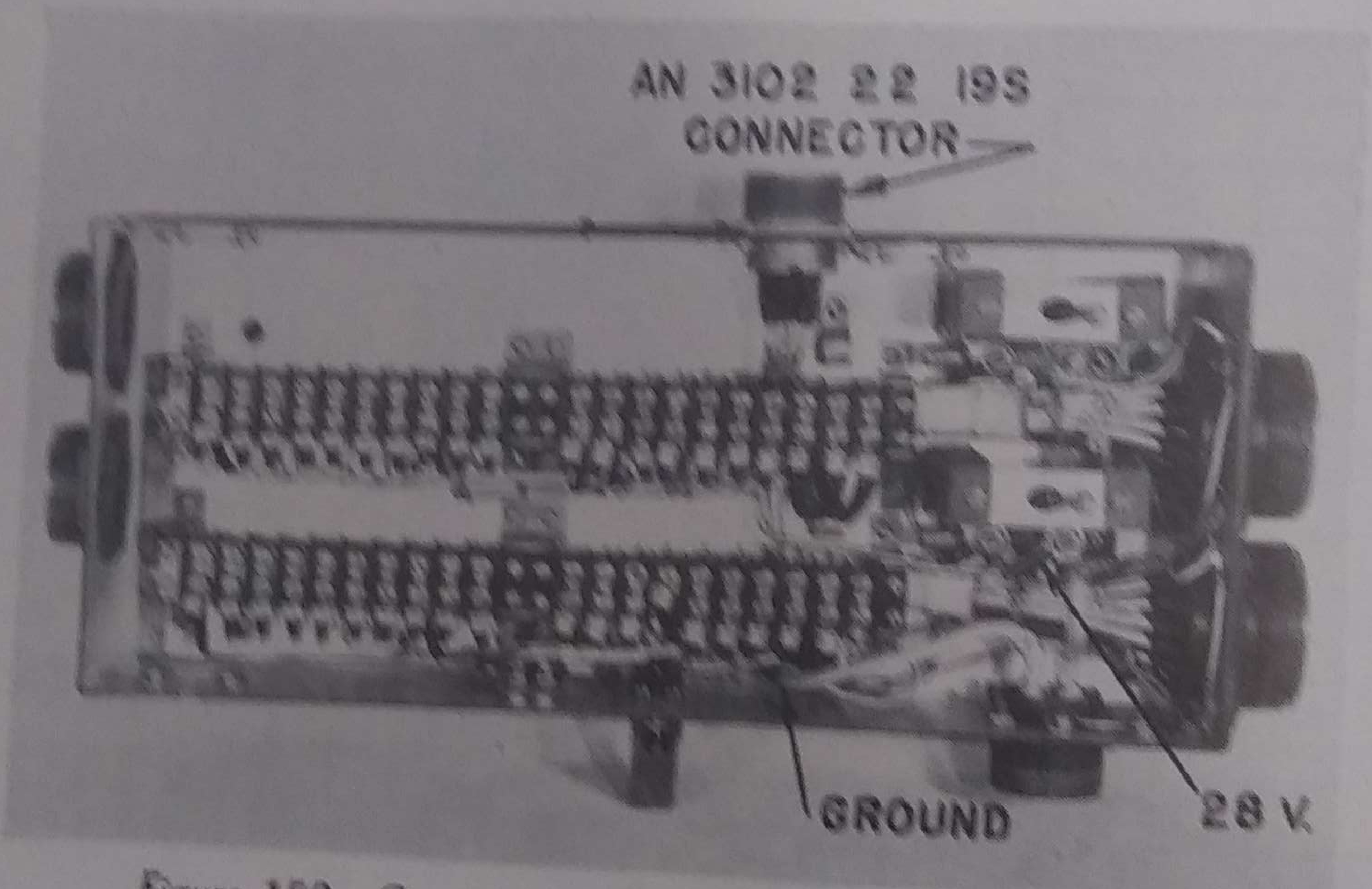

Figure 150—Connection Box Mk 5 Mod 2 as Modified.

Appendix D

CHECKOUT SHEETS FOR SWOD MK 9 (BAT) AND COMPONENTS

The sample checkout sheets, shown on the following pages, are:

1. Navord Form 1564 (Rev. 6–47), Field Check Sheet for SWOD (Radar) Mk 2. Both sides are shown.
2. Navord Form 1564A (Rev. 4–47), Pre-assembly Check Sheet for SWOD Mods 0 and 1. This check sheet contains space for recording the checks made on SWOD (Gyro Panel) Mk 6, SWOD (Servo) Mk 4, SWOD (Control System) Mk 18, and data concerning assembly and loading of missile. Two sides of form are shown.
3. Navord Form 1564B (Rev. 4–47), Operational Data Sheet for SWOD Mk 9.

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